Engineering Management
Field Project

Identifying and Evaluating Energy Cost Reduction Opportunities for Harvesters - The Community Food Network

By

Aaron M. Miller

Spring Semester, 2011

An EMGT Field Project report submitted to the Engineering Management Program
and the Faculty of the Graduate School of The University of Kansas
in partial fulfillment of the requirements for the degree of
Master's of Science

_____
Herb Tuttle
Committee Chairperson

_____
John Bricklemyer
Committee Member

_____
John Conard
Committee Member

Date accepted:_____

Acknowledgements

I would like to thank my committee chair, Herb Tuttle, and committee members, John Bricklemyer and John Conard, for their guidance and feedback. I would also like to thank Norm Bowers, Chief Operating Officer of Harvesters, for providing the needed information and allowing this project's fruition. To the fall semester 2010 course members of EMGT 800: Energy Management, thank you for your contributions and your wonderful service to your community. Lastly, I would like to give a special thank you to my wife, Carrie. Thank you for your patience, support, and encouragement.

Executive Summary

The purpose of this project is to identify and evaluate opportunities where energy costs can be reduced for Harvesters - The Community Food Network. This is accomplished by conducting an energy audit, analyzing the data collected during the audit, and performing an economic analysis. The result is a list of potential capital investments ranked from most favorable to least favorable by internal rate of return.

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1.0 INTRODUCTION

Harvesters - The Community Food Network, known more commonly as Harvesters, is a 501(c)(3) non-profit organization with locations in Kansas City, Missouri and Topeka, Kansas. They were founded in Kansas City, Missouri in 1979 and their Topeka, Kansas location opened in early 2010. Both locations serve as a centralized collection and distribution facility which provides food and household items to non-profit agencies who are members of Harvesters' network. In fiscal year 2010, Harvesters distributed a total of 35.6 million pounds of food and household items to member-agencies who provided assistance to as many as 66,000 people each week (Harvesters 2010a, 2-3).

Currently, Harvesters is the only local-area food bank. Because of this, they serve as the primary source of food for non-profit member-agencies. Harvesters upholds this responsibility with their mission statement: "Harvesters - The Community Food Network feeds hungry people today and works to end hunger tomorrow" (Bowers 2010a). Their mission is supported by:

> 1. Collecting food and household items from community and industry sources.
> 2. Distributing those items and providing nutrition services through a network of non-profit member-agencies.
> 3. Offering leadership and education programs to increase community awareness of hunger and generate solutions to alleviate hunger. (Harvesters)

One of Harvesters' methods to collect donations includes forging partnerships with the local food industry. Once a partnership is formed, the company agrees to donate any food that would have otherwise been dumped. Companies who choose to partner with Harvesters may come from any segment within the industry value chain. Current

representation includes growers, processors, manufacturers, wholesalers, retailers, and restaurants.

Outside the local food industry, other methods are available to collect donated items. Food drives, which are held by individuals, groups, and businesses, are Harvesters' primary source of non-perishable food. The Food Rescue program provides on-site feeding locations, such as soup kitchens and homeless shelters, with prepared foods donated from organizations such as corporate cafeterias and hospitals. Monetary donations, where every dollar is leveraged to buy five meals, are collected to make purchases. Other sources of donations include federal and state grants, other food banks, the United States Department of Agriculture, and membership with a national food bank network, Feeding America. Figure 1.1 shows where the donations come from and the amount of donations collected during fiscal year 2010.

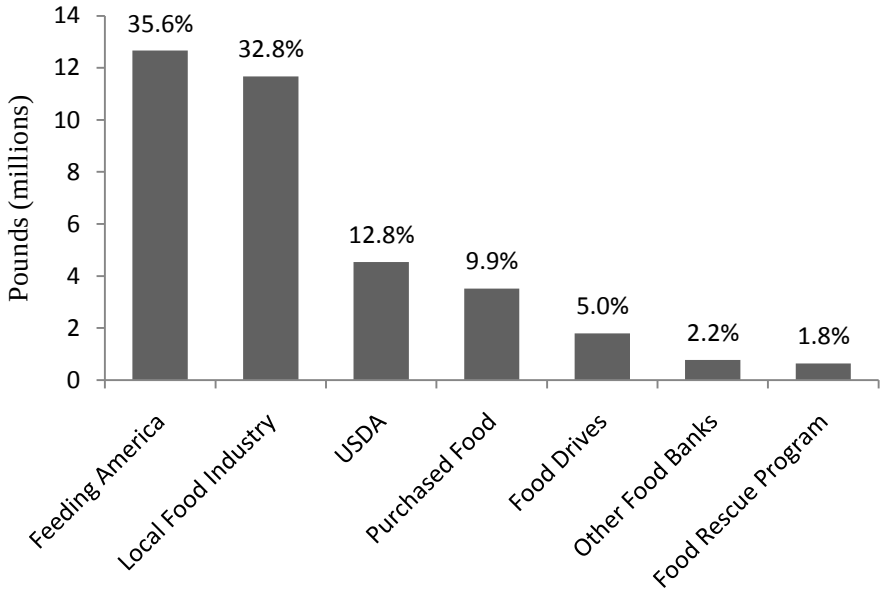


Figure 1.1. Amount and source of collected donations during fiscal year 2010
Source: Data adapted from Harvesters.

Once the process of collecting donations is complete, other steps are required to ensure the donations are distributed to those in need. The next step is transporting donated items to Harvesters' warehouse, which is conducted through the operation of their own trucking fleet. After the donations are at the warehouse, staff and volunteer members sort, and if necessary, repackage them. The donations are then distributed throughout their network of 620 non-profit member-agencies which geographically covers 26 counties throughout northeastern Kansas and northwestern Missouri (Harvesters). The member-agencies include food pantries, soup kitchens, senior centers, homeless shelters, community kitchens, and youth programs, among others. Figure 1.2 shows a map of Harvesters' service area and figure 1.3 depicts the amount and destination of distributed donations during fiscal year 2010.

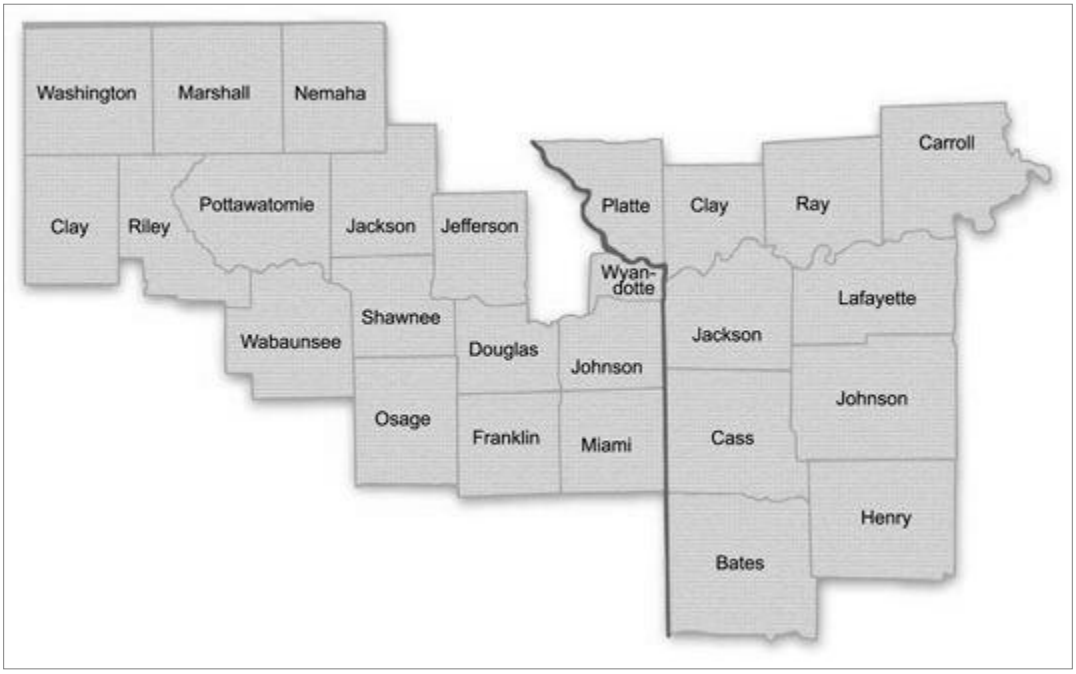


Figure 1.2. Map of Harvesters' service area
Source: Map from Harvesters.

Harvesters has occupied their 216,000 square-foot Kansas City warehouse for approximately five years (Bowers 2010a; Harvesters 2010b, 6). The primary function of

the warehouse is to temporarily store collected donations. Shelf-stable items arriving at the unloading docks are stored in a non-conditioned space. Items requiring refrigeration are unloaded at the cold-dock and stored in Harvesters' 600,000 cubic-foot freezer/cooler (Bowers 2010a). Other functions of the warehouse include a volunteer outreach center where volunteers sort and package food as well as offices and meeting rooms for staff members. Figure 1.4 shows the building layout for Harvesters' Kansas City warehouse.

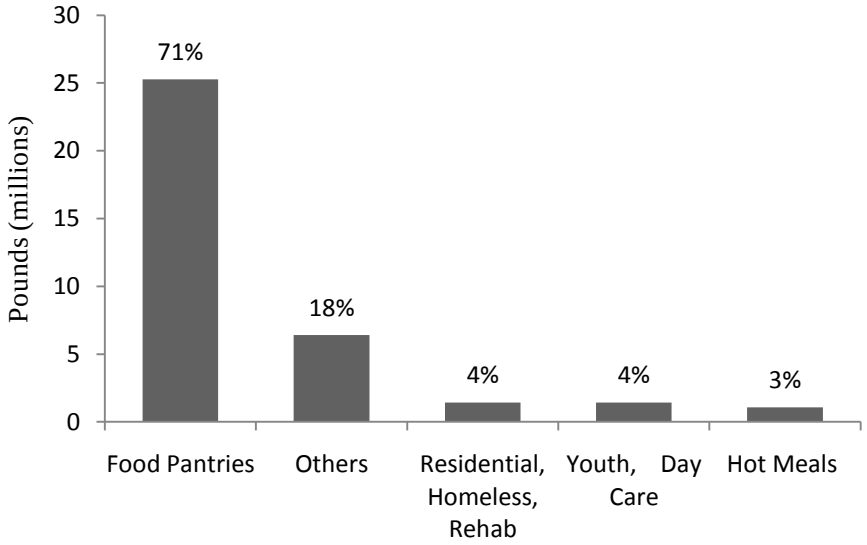


Figure 1.3. Amount and destination of distributed donations during fiscal year 2010
Source: Data adapted from Harvesters.

All donated items, whether or not they require refrigeration, are entered into Harvesters' voice-operated inventory system. After the donations are received, sorted, and packaged, they are stacked on pallets, shrink-wrapped, and stored on three and four-tier shelves which are accessible with forklifts. Each section of the shelving unit is assigned a code which is comprised of a series of numbers and letters. The code gives insight to the location's aisle number, tier-level letter, and the odd or even-numbered side of the unidirectional aisle. Each unidirectional aisle is color-coded by using green for the entrance and red for the exit while the left side of the aisle is reserved for odd-numbers

and the right-side for even-numbers. The coded system allows for any type of donation to be stored at any location (Norm Bowers, November 23, 2010, conversation with author). When the donation needs to be retrieved for distribution, the voice-operated inventory system simply communicates the location's code to the forklift operator.

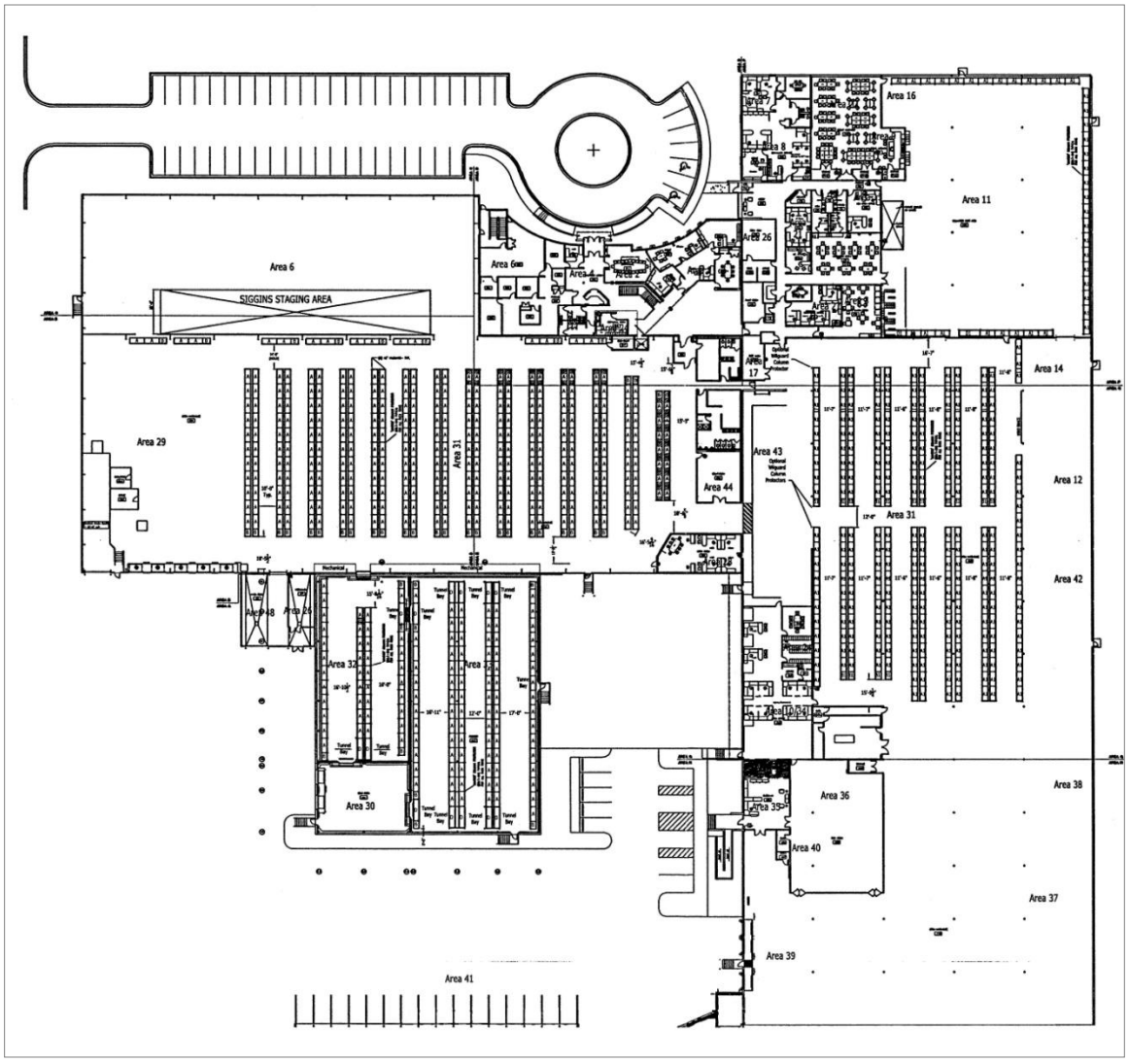


Figure 1.4. Building layout of Harvesters' Kansas City warehouse
Source: Drawing from Bowers 2010b

The storage procedures that are required by the collected donations are implemented by using various types of energy-consuming equipment. Examples of such equipment include heating, ventilation, and air conditioning (HVAC), lighting, forklifts,

and refrigeration. When subjected to an energy audit, each type of equipment can help identify energy cost reduction opportunities. Simply defined, an energy cost reduction opportunity is an opportunity where energy costs can be reduced.

The purpose of this project is to identify and evaluate opportunities where energy costs can be reduced for Harvesters. This is accomplished by conducting an energy audit at their Kansas City warehouse. Upon successfully identifying energy cost reduction opportunities, a financial analysis is performed to evaluate which opportunities are feasible.

The goal of this research is to successfully and inexpensively identify and evaluate energy cost reduction opportunities that result in favorable potential capital investments. The successful identification and evaluation of the opportunities will enable Harvesters to reduce their utility costs and progress toward a strategic goal of reducing their carbon footprint (Harvesters 2010b, 11). The author's support for Harvesters' mission is the primary reason why they are chosen as the recipient for this research.

2.0 LITERATURE REVIEW

A literature review is completed by the author to gain further knowledge of the problem to be solved. Information is collected regarding energy auditing, software programs, and economic analysis. The collected information will help answer the following questions:

1. What does an energy audit entail?
2. How is the utility bill calculated?
3. What type of data is collected for each type of audited equipment?
4. How is software utilized?
5. What financial measures are used?

The subject matter reviewed within the subtopics of energy auditing, software programs, and economic analysis is limited to the conditions of this project. Other than what is discussed in this chapter, the reviewed literature has extensive coverage on other subject matter. The other subject matter includes energy audit procedures for equipment such as boilers, steam systems, cogeneration, waste-heat recovery, building envelope, and compressed air; various types of fuel and their utility bill components such as fuel oil, coal, propane, water, and steam; any number of software programs available from public and private entities both free of charge and at cost; and economic equations such as benefit-cost ratio, annual worth, and future worth.

2.1 Energy Audit Approach

To properly identify and evaluate energy cost reduction opportunities, an energy audit must be completed. An energy audit can be defined as “a detailed examination of how a facility uses energy” (Capehart, Spiller, and Frazier 2007, 23) or “identifying

where a building or plant facility uses energy" (Thumann and Mehta 2008, 33). A more exact definition can be given as "a process to evaluate where a building or plant uses energy, and identify opportunities to reduce consumption" (Thumann and Younger 2008, 1).

2.1.1 Types/Levels

There are essentially three types or levels of energy audits. In increasing order of complexity, effort, and cost, they can be labeled as (1) walk-through, (2) standard, and (3) comprehensive. The walk-through audit is a "tour of the facility to visually inspect each of the energy using systems" (Thumann and Younger 2008, 1). The standard audit goes one step further by utilizing "tests and measurements to quantify energy uses" (Thumann and Mehta 2008, 33) and the comprehensive audit goes even further by involving the use of "energy simulation computer software" (Beggs 2002, 75).

2.1.2 Process

The process of conducting an energy audit can be divided into three steps. They are (1) pre-site, (2) site visit, and (3) post-site. The pre-site work consists of gathering information "likely to affect the energy use in the facility" (Capehart, Turner, and Kennedy 2008, 62) such as utility bills, building layout, and operating hours. The site visit consists of at least a level-one audit to "obtain general information" (Capehart, Spiller, and Frazier 2007, 29) and if progressing through higher levels, a more detailed collection of data is required. The post-site work is when the evaluation of opportunities "is determined using both energy savings and economic analysis" (Krarti 2000, 6).

2.1.3 Utility Bill Components

Understanding the utility bill and how energy is billed is crucial to identifying opportunities. To understand how energy is billed, "the auditor must determine the rate

structure under which that energy used is billed" (Capehart, Spiller, and Frazier 2007, 26). In most cases, the type of rate structure can be found on the billing statement.

2.1.3.1 Electricity

Depending on the rate structure, the electric utility bill can be extremely simple or very complex. In either case, it is wise to know how the charges are calculated. The following components are reviewed:

1. Customer Charge: A flat monthly fee that covers the cost of providing a meter, reading the meter, sending a bill, etc.

2. Energy Charge: A charge for the amount of energy consumed in kilowatt-hours (kWh). It is derived from the cost of fuel consumed for the production of each kWh and operation and maintenance expenses.

3. Sliding Block: Unlike a flat-rate structure, the sliding block rate can either increase or decrease in cost ($/kWh) as more energy is used.

4. Demand Charge: A charge for the amount of electric power used in kilowatts (kW). Generally, this is calculated from a peak measurement that is averaged over a short period of time such as 15 or 30 minutes. It is derived from the cost of having oversized equipment on standby.

5. Ratchet Charge: Related to the demand charge, it is a charge for the highest monthly demand that is either used in the previous 11 months or the current month. It is derived from having a large capacity of oversized standby equipment that is capable of meeting a demand that may occur for only a few months of the year.

6. Seasonal Pricing: A pricing strategy that uses different energy and/or demand charges during winter and summer months. A higher rate is typical during the summer months due to notably higher consumption caused by the cooling of buildings.

7. Power Factor Charge: A charge for having a poor power factor. Billing methods may include the power factor charge with the demand charge or utilize a direct charge for each kilovar (kVAR) used above a set minimum.

To better understand the difference between energy charge, which is commonly referred to as electricity usage or electricity consumption, and demand charge, which is commonly referred to as electric demand or electric power, an analogy is used. "A helpful analogy is to think of an automobile where the speedometer measures the rate of

travel in miles per hour, and the odometer measures the total miles traveled. In this instance, speed in analogous to electric power, and miles traveled is analogous to total energy consumed" (Capehart, Turner, and Kennedy 2008, 93). In other words, if five lamps each containing 100 Watt light bulbs are turned on and operating at the same time, the total electric power that is demanded by the lamps would equal 500 Watts. Taking the same five lamps and one by one turning them on and then off, consecutively, making sure the previous lamp is turned off before the next lamp is turned on, would require a total electric power/demand of 100 Watts. If the same five lamps are turned on and have been operating at the same time for ten hours, the total electricity usage would equal five kWh, or 0.5 kW multiplied by ten hours. If the lamps are turned on and off consecutively, leaving each lamp on for two hours before moving onto the next, the total electricity usage would equal one kWh, or 0.1 kW multiplied by two hours and added (or multiplied) five times.

2.1.3.2 Natural Gas

Unlike the electric utility bill, the natural gas bill is usually simpler. This is primarily caused by the rare existence of demand and ratchet charges (Krarti 2000, 59). Relevant components that are similar to those of the electric rate structure include the customer charge, seasonal pricing, and energy charge. Exceptions include a delivery charge, which is based off of how much natural gas is consumed, and the unit of measurement of natural gas consumption, which is usually measured in therms, hundreds of cubic feet (ccf), or thousands of cubic feet (mcf), depending on the utility.

2.1.4 Equipment

The type of equipment subjected to an energy audit will most likely depend on the type of facility involved. The custom list is generated during a level one audit and is

derived from “facility equipment and operation that will lead to identifying the significant energy conservation opportunities” (Capehart, Spiller, and Frazier 2007, 30). Upon determination of the equipment, a detailed collection of data is required for each type of equipment.

2.1.4.1 Lighting

To accurately perform a lighting audit, multiple data points must be collected for later analysis. The data points help the auditor “perform an objective evaluation of the lighting system” (Capehart, Turner, and Kennedy 2008, 209). The data points can be recognized as (1) the operating hours and days when lighting is required, (2) type of lamps, (3) number of lamps per fixture, (4) number of fixtures, (5) ballast and lamp wattage, and (6) control methods (Capehart, Turner, and Kennedy 2008, 209; Thumann and Younger 2008, 162). The collected data is then analyzed with the purpose of reducing the lighting system’s electrical consumption.

As observed by Krarti (2000, 127), Beggs (2002, 237), and Woodroof and Fetters (2007, 367), the analysis can be separated into three categories. The first category focuses on reducing the wattage of the lights and ballast which can be achieved through energy-efficiency improvements. The second category focuses on reducing how long the lighting system is used through the use of controls. The third category focuses on changing the light quantity and quality by reducing the number of lamps if the area is over-illuminated or by re-examining the first category if the area is under-illuminated.

2.1.4.2 Refrigeration

Two areas for reducing the refrigeration’s consumption are reviewed: infiltration and lighting. Infiltration is when unwanted warmer air is introduced into the refrigeration system. This is caused through the opening and closing of doors and the loading and

unloading from docks. In a refrigerated system, "the infiltration load is one of the major loads" (Stoecker 1998, 612-613), and can vary "from about one-fourth to one-third of the total refrigeration load" (Stoecker 1998, 613). Thumann and Younger respond to the infiltration load with a solution of using vinyl strips, which is "approximately 90% efficient" (Thumann and Younger 2008, 119). Other possible solutions are air curtains and vestibules. Stoecker (1998, 613) describes the infiltration load as:

$$q = \dot{m} \times (h_{a,o} - h_{a,i}),$$

where q is the refrigeration load in kW (Btu/s), $h_{a,o}$ & $h_{a,i}$ is the enthalpy of warm and cold air, respectively, in kJ/kg (Btu/lb), and $\dot{m}$ is the mass flow rate in kg/s (lb/s) which is defined as $\dot{m} = Q \times [(\rho_o + \rho_i)/2]$, where ρ_o & ρ_i is the air density of warm and cold air, respectively, in kg/m^3 (lb/ft^3), and Q is the volume rate of flow in m^3/s (ft^3/s) which is defined as $Q = (C_{inf})(A\sqrt{H})[(\rho_i - \rho_o)/\rho_i]^{1/2}\left[2/\left[1 + (\rho_i/\rho_o)^{1/3}\right]\right]^{3/2}$, where C_{inf} is the infiltration coefficient of 0.692 $\sqrt{m}$/s (1.254 $\sqrt{ft}$/s), A is the doorway area in m^3 (ft^3), and H is the doorway height in m (ft). The enthalpy and density of warm and cold air can be found using psychrometric charts.

In addition to infiltration, lighting located inside the refrigeration system also produces a load. The load is caused from heat which is emitted when the lights are on. Thumann and Mehta (2008, 209) describe heat gain from the lighting system as:

$$Q = (kW_F + kW_B) \times 3412,$$

where Q is the heat gain in Btu/hr, $kW_F$is the kW of the lighting fixtures, $kW_B$is the kW of the ballast, and 3412 is the conversion factor. From this, it can be recognized that solutions to reduce heat gain are those which reduce the power consumption of the lighting fixture and ballast.

2.1.4.3 Demand Shifting

Demand shifting is a result from knowing how electricity is billed. It is utilized by turning non-essential equipment off when the peak demand is approached. Methods to reduce peak demand can include forcing non-essential equipment to operate during off-peak times and using demand-limiting which turns off equipment as a preset amount is arrived at (Thumann and Mehta 2008, 303). Such methods can be supported by employing computerized energy management control systems, programmable logic controllers, and fixed logic controllers. As Capehart, Turner, and Kennedy (2008, 348) recommends, the control system under consideration should depend on how many control points (switch, thermostat, etc.) are present.

2.1.4.4 HVAC

To perform an audit on the HVAC system, multiple steps can be taken. Angevine and Fair explain step one as "find out what you have to work with," (Angevine and Fair 2007, 247) and step two as "determine how the system is operating" (Angevine and Fair 2007, 247). Step one refers to the existing equipment and control systems which can be subdivided into heating and cooling systems and ventilation systems. Step two refers to quantitative measurements, discussions with system operators, usage hours, and temperature settings.

Possible energy cost reduction opportunities, as related to the data acquisition steps, are highly dependent on the type of equipment and control system in use. Angevine and Fair state that "one of the greatest causes of energy waste is unnecessary operation" (Angevine and Fair 2007, 261). It is also stated that "inadequate or improper maintenance is a major cause of system inefficiency" (Angevine and Fair 2007, 261). Other possible opportunities may concern the design of the system such as type of filters and other parts,

zones, and the system's configuration. However, "it is not wise to undertake modifications of an HVAC system . . . without considering the effects on thermal comfort, air quality, and airflow requirements" (Angevine and Fair 2007, 260).

2.2 Software Programs

The author recognizes the potential complexity involved in analyzing audited equipment. To remedy this, the author chooses to implement software programs for HVAC, refrigeration infiltration, and a portion of refrigeration lighting. The reviewed software programs, e-QUEST and Calc-Rite, are chosen for the following reasons: (1) their introduction in EMGT 800: Energy Management, (2) difficulty of finding other suitable/free software, especially with refrigeration, (3) they are easy to obtain and start using, and (4) they are user-friendly.

2.2.1 e-QUEST v3.64

e-QUEST (the QUick Energy Simulation Tool) is a free building energy-use analysis tool and simulation program. It utilizes user-friendly wizards to help create a building model and the DOE-2.2 program as its simulation engine. DOE-2.2 is an advanced version of DOE-2 which was developed jointly by Lawrence Berkeley National Laboratories and J.J. Hirsch and Associates under funding from the United States Department of Energy and the Electric Power Research Institute (Hirsch). Currently, e-QUEST and all versions of DOE-2 are funded both publicly and privately and are maintained privately.

The primary function of e-QUEST is to simulate HVAC-based systems and their associated loads. Upon completion of re-creating the building shell, a base model is created by specifying any of the 60 different types of HVAC systems along with their

zones, controls, utility rate structures, and hours of operation. Alternative models are then compared to the base model to report their energy and cost saving differences. Next to user-specified inputs, e-QUEST automatically imports local weather data. The model is simulated on an hourly basis for 8760 hours for any year specified by the user.

2.2.2 Calc-Rite v1.82

Calc-Rite is a free refrigeration load program by KeepRite Refrigeration, a designer and manufacturer of refrigeration components in North America. A feature of Calc-Rite is it calculates how much load, in Btu/h or Watts, is presented to the refrigeration system through infiltration, lighting, and other heat generating sources. Since Calc-Rite is not capable of simulation, an iterative process is needed by approximating its input variables to a predetermined frequency to represent annual temperature and relative humidity changes.

2.3 Economic Analysis

When energy cost reduction opportunities are evaluated, their potential energy and cost reducing investment, or capital investment, must have favorable results. The results are determined from performing an economic analysis which can use any number of available measures. While there are numerous measures to determine favorable results, "the basic criterion for evaluating any investment decision is that the revenues (savings) generated by the investment must be greater than the costs incurred" (Pratt 2007, 41). Several authors agree with the common types of financial measures used (Capehart, Turner, and Kennedy 2008, 131-172; Krarti 2000, 65-90; Pratt 2007, 41-86; Thumann and Mehta 2008, 15-31; Thumann and Younger 2008, 47-86).

Simple Payback Period (SPP) is the least complicated and most commonly used financial measure. It is used to determine how many years will lapse before the initial investment is paid back through annual savings. It can also be used as an initial decision tool. The primary drawbacks of using SPP are: (1) it does not consider any savings beyond the payback time period, (2) it does not consider the time value of money, and (3) it does not account for the investment's expected life. SPP is determined by the following equation: SPP = (Initial Cost)/(Annual Savings).

Present Worth (PW) is used to convert all future cash flow savings throughout the investment's expected life to present values. Also referred to as Net Present Worth (NPW) and Net Present Value (NPV), it requires a known value for the minimum attractive rate of return (MARR). If the result is positive, then the investment should be accepted, if the result is negative, then the investment should be rejected. The equation for PW is:

$$PW = \sum_{t=0}^{n} [A_t \times (P|F, i, t)],$$

where A_t is the annual cash flow savings at time t and $(P|F, i, t)$ is the present value of the future cash flow of known interest rate i (MARR) at time t. It is calculated by using $(1 + i)^{-t}$.

Internal Rate of Return (IRR) is a measure that calculates the rate of return that is internal to the project. It does not rely on the MARR and is found by setting PW to zero and solving for the interest rate. Since this is an iterative process, the IRR can easily be computed using spreadsheets and financial calculators. If IRR is greater than MARR, the investment is attractive, otherwise it should be rejected. IRR is computed by:

$$find\ IRR\ such\ that\ PW = \sum_{t=0}^{n} [A_t \times (P|F, IRR, t)] = 0,$$

where A_t is the annual cash flow savings at time t and $(P|F, IRR, t)$ is the present value of the future cash flow of unknown interest rate IRR at time t. It is calculated by using $(1 + IRR)^{-t}$.

2.4 Summary

To properly identify and evaluate energy cost reducing opportunities, an energy audit must be completed. The three types/levels of an energy audit are: (1) walk-through, (2) standard, and (3) comprehensive. The three-step process to perform the necessary work is: (1) pre-site, (2) site visit, and (3) post-site. Upon determining the type/level of energy audit, the pre-site work can consist of evaluating the utility bills, such as electricity and natural gas. The site visit consists of auditing a specified list of equipment, such as lighting, refrigeration, demand shifting, and HVAC.

The post-site work consists of data evaluation. Software can be utilized to accomplish this task as well as hand calculations. This is also when energy savings, cost savings, and potential capital investment costs are determined. Using financial measures, such as SPP and IRR, an economic analysis is performed to determine the favorable investments.

2.5 Conclusion

Upon reviewing the collected literature, a better understanding of how to solve this project's problem is acquired. The reviewed literature within the energy auditing and economic analysis subtopics does not present any disagreements. A downside to this is the lack of information found on refrigeration infiltration, which requires a secondary

search. The result is information which seems outdated, but is currently used as the standard. Other downsides include the lack of specific solutions to solve the problem. The specific condition of the audited equipment may require an innovative mindset to meet the criteria of the solutions needed. It is observed that most of the authors of the literature review are highly respected within the energy conservation and management profession and are commonly co-authors of each other.

3.0 RESEARCH PROCEDURE

Information from the literature review and coursework and dialogue from EMGT 800: Energy Management is used to create a research procedure to identify and evaluate energy cost reduction opportunities for Harvesters. The intent of this research is to target high energy-consuming equipment and provide inexpensive solutions that result in favorable capital investments. The various stages of the research procedure are outlined below.

3.1 Utility Bill Analysis

The first stage of the research procedure is analyzing data retrieved from utility bills. To perform the analysis, one year of utility data is requested for electricity and natural gas. Once received, each utility is studied to identify energy-usage patterns. The rate structure for each utility is also studied to understand how energy costs are billed.

3.2 Pre-Audit Walk-Through

The second stage of the research procedure is conducting a pre-audit walk-through. This typically involves somebody from the organization who is knowledgeable of the building, daily operations, and equipment usage. The result of the pre-audit walk-through is a list of equipment that is further pursued during the energy audit.

3.3 Energy Audit

The third stage of the research procedure is the energy audit. The energy audit focuses on equipment from the list that is generated during the pre-audit walk-through. Data for each of the equipment is measured and recorded for further analysis performed at a later time. To solve this problem, the author is given permission to use data collected

during the energy audit conducted as part of a class project in EMGT 800: Energy Management in which the author led, managed, arranged, and participated in.

3.3.1 Warehouse Lighting

Required data for warehouse lighting involves several items. These items are (1) number of fixtures, (2) number of lamps in each fixture, (3) type of lamp, (4) lamp wattage, (5) ballast wattage, (6) location of fixtures, (7) operating hours and days, and (8) control methods. A team of two class members volunteered with the collection of this data.

3.3.2 Refrigeration Lighting

Required data for refrigeration lighting is similar to the warehouse lighting. The data needed are (1) number of fixtures, (2) number of lamps in each fixture, (3) type of lamp, (4) lamp wattage, (5) ballast wattage, (6) location of fixtures, (7) operating hours and days, and (8) control methods. A team of two class members volunteered with the collection of this data.

3.3.3 Refrigeration Infiltration

Required data for refrigeration infiltration consists of several components. They are (1) dimension of doors, (2) how doors are opened, (3) approximation of how long doors stay open, (4) temperature gradient, (5) equipment used to deter infiltration, and (6) approximate relative humidity levels. The same team who volunteered to collect the refrigeration lighting data also volunteered with the collection of this data.

3.3.4 Forklift Charging Stations

Required data for the forklift charging stations includes several items. They are (1) load requirements, (2) average length of charging time, (3) time of charging, and (4)

location of chargers. A team of two class members volunteered with the collection of this data.

3.3.5 HVAC

Required data for HVAC involves several items. They are (1) current set-points, (2) control methods, (3) type of units, (4) age of units, (5) zone responsibility of units, and (6) operating hours and days. A team of two class members volunteered with the collection of this data.

3.4 Energy Consumption

The fourth stage of the research procedure is calculating the energy consumption of the audited equipment. This stage utilizes calculations that are completed by hand and by the use of software programs. This stage is completed to establish a baseline which is used in stage five to determine potential savings.

3.5 Energy and Cost Savings

The fifth stage of the research procedure is calculating the energy and cost savings of the audited equipment. Depending on the type of equipment, this is completed by using various types of software. Microsoft Excel is used for hand calculations for the forklift charging stations, warehouse lighting, and refrigeration lighting. e-QUEST is used to evaluate HVAC and Calc-Rite is used to evaluate refrigeration infiltration and a portion of refrigeration lighting. This stage utilizes each utility's rate structure.

3.6 Economic Analysis

The sixth and final stage of the research procedure is determining capital investments and calculating financial measures. The computed cost of the capital investments includes procurement, installation, operation, and maintenance. This is

computed to complete the financial measures of SPP and IRR. The financial measures are ranked to easily compare the potential capital investments.

4.0 RESULTS

This chapter focuses on the results of conducting an energy audit at Harvesters. A utility bill analysis is presented along with the data collected during the energy audit. The data is then analyzed for energy consumption and energy and cost savings. Lastly, capital investment costs are presented along with an economic analysis.

4.1 Utility Bill Analysis

Data for the electric and natural gas utility bills are requested and received for analysis. Upon receiving the bills, the rate structure for each utility is identified and accessed for further assessment. Data from the utility bills and their respective rate structures are conveyed for each utility. Appendices A and B further describe the utility bill and their rate structure by providing a single-month billing statement and a single page from the rate structure for the electric and natural gas utility, respectively.

4.1.1 Electricity

Harvesters' electric utility is serviced by Kansas City Power and Light Company (KCPL) and their rate structure is classified as Large General Service (LGS). The components of the rate structure, for service at secondary voltage, in accordance to KCPL (2009, 2-6) are as follows:

1. Customer Charge: This charge is not fixed and is dependent on how much Facilities Demand is used. A charge of $85.22 is applied for 0 - 999 kW and $727.61 for 1000 kW or above.

2. Minimum Demand: For service at secondary voltage, the minimum billable demand is 200 kW.

3. Demand Charge: Under seasonal pricing, a charge of $4.868 per kW per month is applied during the summer season and $2.620 per kW per month is applied during the winter season. It is determined by the highest demand in any 30 minute interval or the minimum demand, whichever is higher.

4. Facilities Charge: This is a fixed price of $2.438 per kW of Facilities Demand per month (KCPL substitutes Facilities Demand for Ratchet Charge). It is determined from the highest demand charge in the last 12 months, including the current month, or the minimum demand, whichever is higher.

5. Energy Charge: This charge utilizes a decreasing sliding block and seasonal pricing. For the first 180 hours of monthly use, a summer charge of $0.0715 per kWh and winter charge of $0.0657 per kWh is applied. For the next 180 hours, the summer charge is $0.0545 per kWh and winter charge is $0.0419 per kWh. For all hours over 360, the summer charge is $0.0426 per kWh and winter charge is $0.0358 per kWh.

6. Seasonal Pricing: The summer season is from May 16 through September 15 while the rest of the months are attributed to the winter season.

Upon receiving Harvesters' electricity bills, it is noticed there are two separate meters and each meter is billed using the LGS rate structure. For the east meter, it is noticed that the highest usage occurs during the months of January, July, August, September, November, and December. For the west meter, the highest usage occurs during July, August, and September. Figure 4.1 and 4.2 shows Harvesters' electricity use and electric demand, respectively, from June 2009 to October 2010.

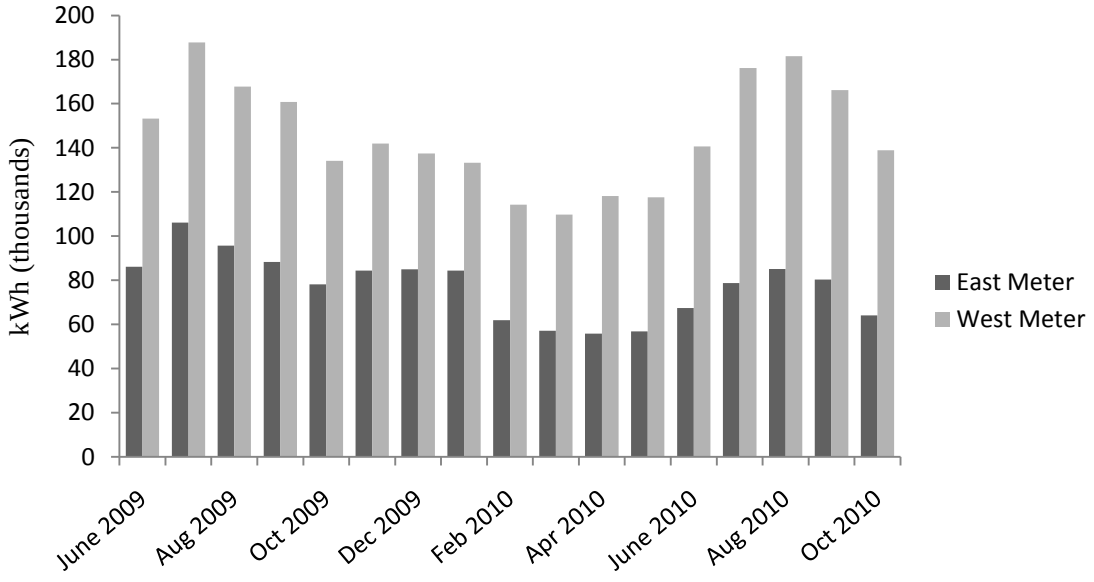


Figure 4.1. Harvesters' electricity use in kWh, June 2009 - October 2010
Sources: Data adapted from Norm Bowers, November 23, 2010, hardcopy of electric utility bills given to author; Norm Bowers, January 31, 2011, e-mail message to author.

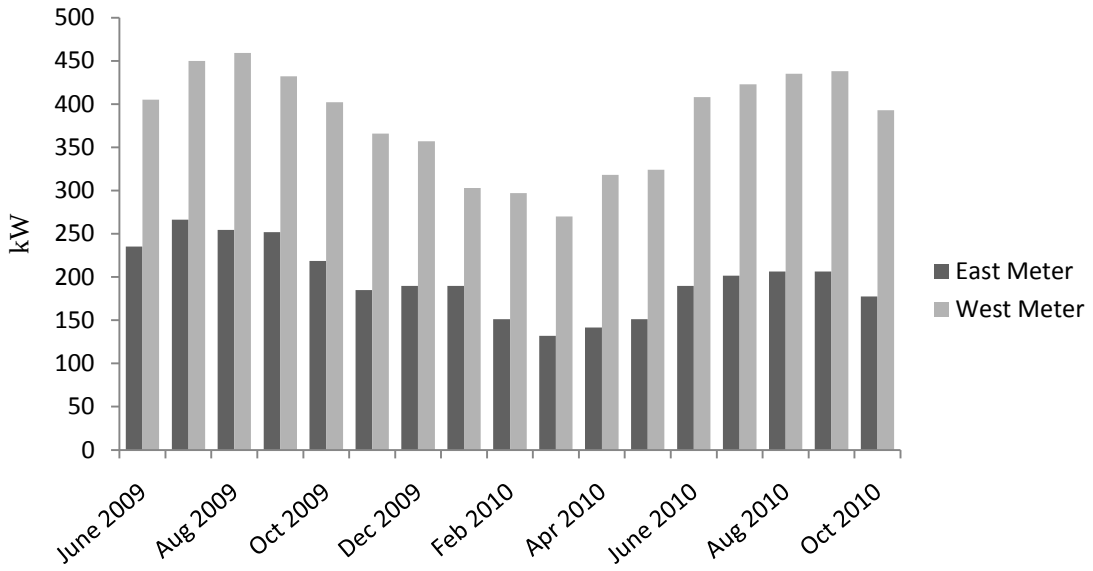


Figure 4.2. Harvesters' electric demand in kW, June 2009 - October 2010
Sources: Data adapted from Norm Bowers, November 23, 2010, hardcopy of electric utility bills given to author; Norm Bowers, January 31, 2011, e-mail message to author.

4.1.2 Natural Gas

Harvesters' natural gas utility is serviced by Missouri Gas Energy (MGE) and their rate structure is classified as Large General Gas Service (LGS). The components of the rate structure consist of a fixed service charge of $111.31 per month, seasonal pricing for the volumetric delivery charge of $0.12798 per ccf for November through March and $0.07376 per ccf for April through October, and a usage charge of $0.82433 per ccf (MGE 2010, 4).

Upon receiving Harvesters' natural gas bills, it is noticed that most of their usage occurs during the months of January, February, and March with slightly less usage occurring in April, September, October, November, and December. It is also noticed that a usage spike of approximately 30,000 ccf occurred in October 2009, possibly due to a billing or meter error, and the history prior to this date is absent. Figure 4.3 reflects Harvesters' natural gas usage from November 2009 to September 2010.

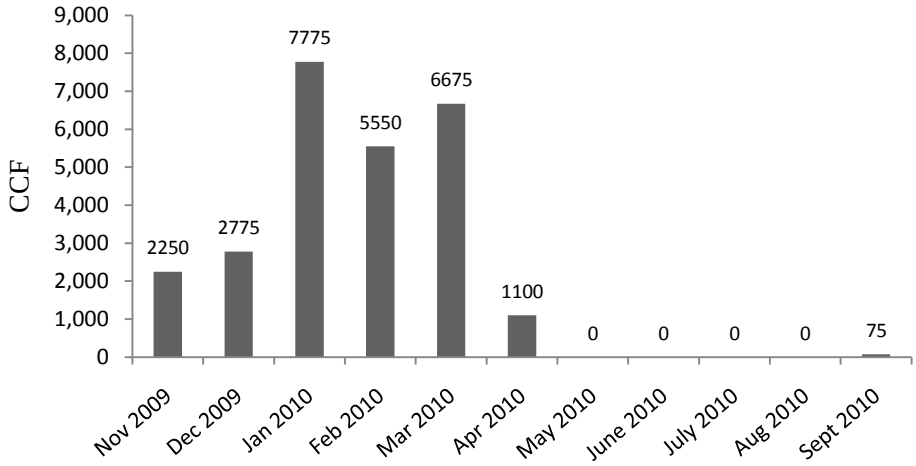


Figure 4.3. Harvesters' natural gas use in ccf, November 2009 - September 2010
Source: Data adapted from Norm Bowers, November 23, 2010, hardcopy of natural gas utility bills given to author.

4.2 Data Collection

The energy audit conducted at Harvesters focuses on the equipment list constructed during the walk-through audit. The equipment includes warehouse lights, refrigeration lights, refrigeration infiltration, forklift charging stations, and HVAC. Data from the energy audit is described and portrayed for each equipment type.

4.2.1 Warehouse Lighting

The lighting system in Harvesters' warehouse is categorized into four locations. They are labeled as high-bay, low-bay, distribution, and volunteer outreach center (VOC). The approximate ceiling height is 30 feet for the high-bay area, 18 feet for the low-bay area and VOC, and 12 feet for the distribution area. All four areas have been upgraded from metal halide (MH) lighting to T5 high output (HO) and T8 fluorescent lighting. The unidirectional aisles in the shelving/storage areas are equipped with motion sensors and all other areas are controlled manually.

The operating schedule is the same for all four locations. It is Monday and Friday from 6:00 a.m. to 5:00 p.m., Tuesday, Wednesday, and Thursday from 6:00 a.m. to 8:00

p.m., Saturday from 7:00 a.m. to 5:00 p.m., and off on Sunday (Bowers 2010a). Table 4.1 shows the audit data for the warehouse lights.

Table 4.1. Audit data for warehouse lighting

Location	Lamp Type	Number of Fixtures	Lamps per Fixture	Lamp Wattage (W)	Ballast Wattage (W)	Control Method
High-Bay						
Non-shelving	T5HO	58	6	54	32.4	Manual
Shelving	T5HO	70	6	54	32.4	Motion Sensor
Low-Bay						
Non-shelving	T5HO	48	6	54	32.4	Manual
Shelving	T5HO	39	6	54	32.4	Motion Sensor
Distribution	T8	70	4	32	32.0	Manual
VOC	T5HO	30	6	54	32.4	Manual

Sources: Data adapted from Conard 2010, Session 14; Norm Bowers, November 24, 2010, e-mail message to author.

4.2.2 Refrigeration Lighting

The lights in Harvesters' refrigeration systems are categorized into five locations. They are labeled as cooler, cold-dock, freezer, staging cooler, and staging freezer. The primary refrigeration system, consisting of the cooler, cold-dock, and freezer, has an approximate ceiling height of 30 feet. The secondary refrigeration system, consisting of the staging cooler and freezer, has an approximate ceiling height of ten feet. All five locations have the same operating schedule stated in 4.2.1. Table 4.2 shows the audit data for the lights of both refrigeration systems.

Table 4.2. Audit data for refrigeration lighting

Location	Lamp Type	Number of Fixtures	Lamps per Fixture	Lamp Wattage (W)	Ballast Wattage (W)	Control Method
Cooler	MH	8	1	400	60	Manual
Cold Dock	MH	4	1	400	60	Manual
Freezer	MH	15	1	400	60	Manual
Staging Cooler	T8	14	2	32	16	Manual
Staging Freezer	T8	8	2	32	16	Manual

Source: Data adapted from Conard 2010, Session 14.

4.2.3 Refrigeration Infiltration

Harvesters' primary refrigeration system has a total of six doors. Four of the six doors are opened automatically by motion sensors while the two cold-dock doors are opened manually. Currently, the north cooler door is equipped with an air curtain to reduce infiltration; however, it has been decommissioned due to unsatisfactory results. The secondary refrigeration system is not audited due to the existence of vinyl strips. Table 4.3 shows the audit data for refrigeration infiltration. The doors are labeled by refrigeration section and location within each section.

Table 4.3. Audit data for refrigeration infiltration

Door Location	Dimension (width x height) (ft)	Open Duration (sec)	External Temperature (°F)	Internal Temperature (°F)	Internal Relative Humidity[b] (%)
Cooler - North	8 x 12	20	70[a]	38	45
Cooler - East	8 x 12	20	-5	38	45
Cooler - South	8 x 12	20	38	38	45
Cold Dock - North	8 x 12	20	38	38	45
Cold Dock - East	8 x 12	20	-5	38	45
Cold Dock - West (North)	8 x 10	. . .	70[a]	38	45
Cold Dock - West (South)	8 x 10	. . .	70[a]	38	45
Freezer - West (North)	8 x 12	20	38	-5	35
Freezer - West (South)	8 x 12	20	38	-5	35

Source: Data adapted from Conard 2010, Session 14.

[a]Temperature is external to the refrigeration system and is dependent on outside temperatures.

[b]Relative humidity data are estimates.

4.2.4 Forklift Charging Stations

The forklift battery charging stations are in two locations. The first station is located in the low-bay area and the second in the high-bay area. The initial charging time for the forklifts starts at the end of the workday at approximately 3:30 p.m. and charges for an average duration of four hours. Table 4.4 shows the audit data for the forklift charging stations.

Table 4.4. Audit data for the forklift battery charging stations

Location	Voltage (V)	Amperage (A)	Phase	Power Factor
Station 1 - Low-Bay Area				
Charger 7	480	5	1	0.75
Charger 8	480	6	1	0.75
Charger 9	480	6	1	0.75
Charger 10	480	9	1	0.75
Charger 11	480	8	1	0.75
Charger 12	480	10	1	0.75
Charger 13	480	5	3	0.85
Charger 21	480	9	1	0.75
Charger 27	480	8	3	0.85
Charger 29	480	8	1	0.75
Charger 30	480	8	1	0.75
Charger 35	480	8	1	0.75
Station 2 - High-Bay Area				
Charger 1	480	10	3	0.85
Charger 5	480	16	3	0.85
Charger 6	480	16	3	0.85
Charger 17	480	8	3	0.85
Charger 18	480	10	3	0.85
Charger 28	480	14	3	0.85
Charger 33	480	13	3	0.85
Charger 34	480	8	1	0.75
Charger 39	480	15	3	0.85

Source: Data adapted from Conard 2010, Session 14.

Note: Power factor data are estimates.

4.2.5 HVAC

Harvesters' HVAC units, which are aged approximately 15 years, are classified into three groups. The first group, consisting of one unit, is a Carrier variable-air-volume (VAV) system which serves both floors of the west office with the exception of the employee break room. It is controlled by Carrier's proprietary thermostats. The second group, consisting of nine units, is comprised of single-zone rooftop units (RTU). They serve various zones throughout the east and warehouse office spaces and are controlled by Delta programmable thermostats. The third group, consisting of six units, is comprised of single-zone units (SZU). Units one through five provide heating only and unit six

provides heating and cooling. Unit six serves the VOC and units one through five serve all other warehouse areas. All six SZU's are controlled by individual programmable thermostats. Table 4.5 shows the audit data for the HVAC system.

Table 4.5. Audit data for HVAC

	Day Setpoint		Night Setpoint	
Zone	Heating (°F)	Cooling (°F)	Heating (°F)	Cooling (°F)
Carrier VAV	72.0	72.0	65	80
RTU 1 - Shopping Floor	67.5	69.5	65	80
RTU 16 - Hunger Awareness Center	70.0	70.0	65	80
RTU 17 - Community Service	71.5	73.5	65	80
RTU 18 - VOC Office & Entrance	74.0	76.0	65	80
RTU 19 - IT Office	68.0	70.0	65	80
RTU 20 - Employee Break Room	71.5	73.5	65	80
RTU 23 - Warehouse Office	69.0	72.0	65	80
RTU 30 - Agency Services Office	70.0	77.0	65	80
RTU 31 - Check In	67.0	69.0	65	80
SZU 1 - High-Bay North	55.0	. . .	55	. . .
SZU 2 - High-Bay West	55.0	. . .	55	. . .
SZU 3 - Low-Bay West	55.0	. . .	55	. . .
SZU 4 - Low-Bay East	55.0	. . .	55	. . .
SZU 5 - Distribution	55.0	. . .	55	. . .
SZU 6 - VOC	60.0	60.0	60	80

Sources: Data adapted from Conard 2010, Session 15; Norm Bowers, November 24, 2010, e-mail message to author.

The operating schedule for Harvesters' HVAC units is separated in four groups. The first group, RTU 1, operates Monday through Saturday from 3:00 a.m. to 10:00 p.m. and is off on Sunday. The second group, Carrier VAV and the balance of the RTU's, operates Monday through Friday from 5:00 a.m. to 6:00 p.m., Saturday from 5:00 a.m. to 1:00 p.m., and is off on Sunday. The third group, SZU 6, operates Tuesday through Thursday from 8:00 a.m. to 8:00 p.m., Friday and Saturday 8:00 a.m. to 5:00 p.m., and is off on Sunday and Monday. The fourth group, the balance of the SZU's, operates 24 hours per day Sunday through Saturday when the temperature is less than 55 degrees Fahrenheit.

4.3 Data Analysis

The data collected during the energy audit is analyzed for energy consumption and energy and cost savings. The data is organized by type of equipment and in some cases, is further organized by electric meter. The east electric meter, associated with the east side of the building, consists of the east offices, VOC, low-bay area, distribution area, and staging cooler and freezer. The west electric meter, associated with the west side of the building, consists of the west office, high-bay area, and the walk-in cooler, freezer, and cold-dock.

4.3.1 Energy Consumption

Since each type of equipment does not use sub-metering, their energy consumption is approximated. By utilizing Microsoft Excel, this is completed from hand-calculations for warehouse lighting, forklift charging stations, and a portion of the refrigeration lighting. By utilizing e-QUEST and Calc-Rite, this is completed for HVAC, refrigeration infiltration, and the balance of refrigeration lighting. A load profile is summarized for all types of equipment associated with each utility meter.

4.3.1.1 Warehouse Lighting

The energy consumption for warehouse lighting is calculated for all four locations. Areas controlled manually are calculated using the operating schedule stated in 4.2.1. Areas controlled by motion sensors are calculated using 50 percent of Monday's work schedule for five days of the week.

The 50 percent usage factor associated with the lights in the unidirectional shelving aisles is estimated from the difference of the weekly operating schedule, which is the operating time for the non-shelving or manually controlled lights, and the schedule for the majority of the forklift operators, which is approximately 40 hours per week from

6:30 a.m. to 3:30 p.m. In addition, the lights are activated for two minutes before returning to their off state, which can further reduce their usage factor. Table 4.6 shows each location's weekly energy consumption for warehouse lighting.

Table 4.6. Weekly energy consumption for warehouse lighting

Location	Fixture Wattage (W)	Electric Demand (kW)	Operating Hours (hr)	Electricity Use (kWh)
High-Bay				
Non-shelving	356.4	20.67	74.5	1540
Shelving	356.4	24.95	27.5	1301
Low-Bay				
Non-shelving	356.4	17.11	74.5	1274
Shelving	356.4	13.90	27.5	725
Distribution	160.0	11.20	74.5	834
VOC	356.4	10.69	74.5	797

4.3.1.2 Refrigeration Lighting

The energy consumption for refrigeration lighting is calculated for each location. Since all locations are manually controlled, the operating hours are equivalent to those stated in 4.2.2. Heat emitted from refrigeration lighting is calculated using Calc-Rite. Table 4.7 shows the weekly energy consumption for refrigeration lighting.

Table 4.7. Weekly energy consumption for refrigeration lighting

					Heat Load	
Location	Fixture Wattage (W)	Operating Hours (hr)	Electric Demand (kW)	Electricity Use (kWh)	Electric Demand (kW)	Electricity Use (kWh)
Cooler	460	74.5	3.68	274	2.857	274.27
Cold Dock	460	74.5	1.84	137	1.428	137.09
Freezer	460	74.5	6.90	514	5.356	514.18
Staging Cooler	80	74.5	1.12	83	0.870	83.52
Staging Freezer	80	74.5	0.64	48	0.442	42.43

Note: Heat load is calculated using an assumed refrigeration run-time of 16 hours per operating day.

4.3.1.3 Refrigeration Infiltration

The energy consumption for refrigeration infiltration is calculated for each door within each refrigeration section. Taken from NOAA National Weather Service Climate Office for February 2010 through January 2011, the monthly average temperature and

relative humidity for the Kansas City area is used in the infiltration calculation. Also included in the calculation is the average duration of one hour a day for six days per week for the amount of time the doors are open each day. The energy consumption is calculated using Calc-Rite. Table 4.8 shows the annual energy consumption by month for refrigeration infiltration. Due to zero consumption, the east and south cooler doors and the north and east cold-dock doors are excluded from table 4.8.

Table 4.8. Annual energy consumption by month for refrigeration infiltration

		Cooler		Cold Dock		Freezer	
		North Door		West Doors (North & South)		West Doors (North & South)	
Month	Operating Days (day)	Electric Demand (kW)	Electricity Use (kWh)	Electric Demand (kW)	Electricity Use (kWh)	Electric Demand (kW)	Electricity Use (kWh)
January	26	1.752	728.83	2.665	1108.64	9.562	3977.79
February	24	1.752	672.77	2.665	1023.36	9.562	3671.81
March	27	2.493	1076.98	3.793	1638.58	9.562	4130.78
April	26	3.671	1527.14	5.585	2323.36	9.562	3977.79
May	26	7.919	3294.30	12.048	5011.97	9.562	3977.79
June	26	9.656	4016.90	14.692	6111.87	9.562	3977.79
July	27	9.144	3950.21	13.912	6009.98	9.562	4130.78
August	26	5.191	2159.46	7.897	3285.15	9.562	3977.79
September	26	2.012	836.99	3.061	1273.38	9.562	3977.79
October	26	1.502	624.83	2.285	950.56	9.562	3977.79
November	26	1.627	676.83	2.475	1029.60	9.562	3977.79
December	27	1.752	756.86	2.665	1151.28	9.562	4130.78

Note: Infiltration is calculated using an assumed refrigeration run-time of 16 hours per operating day.

4.3.1.4 Forklift Charging Stations

The energy consumption for the forklift battery charging stations is calculated for each electric meter. An average charge length of four hours per day for five days per week is used in the calculation along with a 90 percent load factor. Table 4.9 shows the weekly energy consumption for the forklift battery chargers.

Table 4.9. Weekly energy consumption for the forklift battery charging stations

Location	Electric Demand (kW)	Electricity Use (kWh)
East Meter - Station 1	33.216	664.32
West Meter - Station 2	67.465	1349.30

4.3.1.5 HVAC

The energy consumption for HVAC is calculated for each electric meter using e-QUEST. The east electric meter is associated with RTU's one, 16, 17, 18, 19, 30, and 31, and SZU's three, four, five, and six. The west electric meter is associated with RTU's 20 and 23, SZU's one and two, and Carrier VAV. Table 4.10 shows the annual energy consumption by month for HVAC and appendix C illustrates the e-QUEST model for the east-metered building, west-metered building, and complete building.

Table 4.10. Annual energy consumption by month for HVAC

	East Meter		West Meter		
Month	Electric Demand (kW)	Electricity Use (kWh)	Electric Demand (kW)	Electricity Use (kWh)	Natural Gas Use (ccf)
January	10.6	3470	14.5	10,600	8856
February	13.1	3180	14.5	9600	6551
March	20.0	3870	18.1	10,600	4392
April	67.4	6840	37.7	11,200	1354
May	67.6	9310	40.0	11,900	329
June	85.5	18,000	51.5	15,700	35
July	91.2	24,800	56.4	19,400	1
August	89.1	21,820	54.6	17,300	25
September	66.9	12,760	36.4	12,600	152
October	69.2	7400	39.7	11,100	716
November	31.5	4060	19.5	10,200	3500
December	14.1	3440	14.5	10,600	6778

4.3.1.6 Summary

To summarize the energy consumption for each type of audited equipment, a load profile is constructed from the individual calculations and their corresponding operating schedules. The balance of the load is labeled as others and includes items such as refrigeration, office lighting, and miscellaneous equipment. The load profile excludes

natural gas consumption and is completed for both electric meters for any given Wednesday in the month of July. Figure 4.4 and 4.5 illustrates the load profile for the east and west meter, respectively.

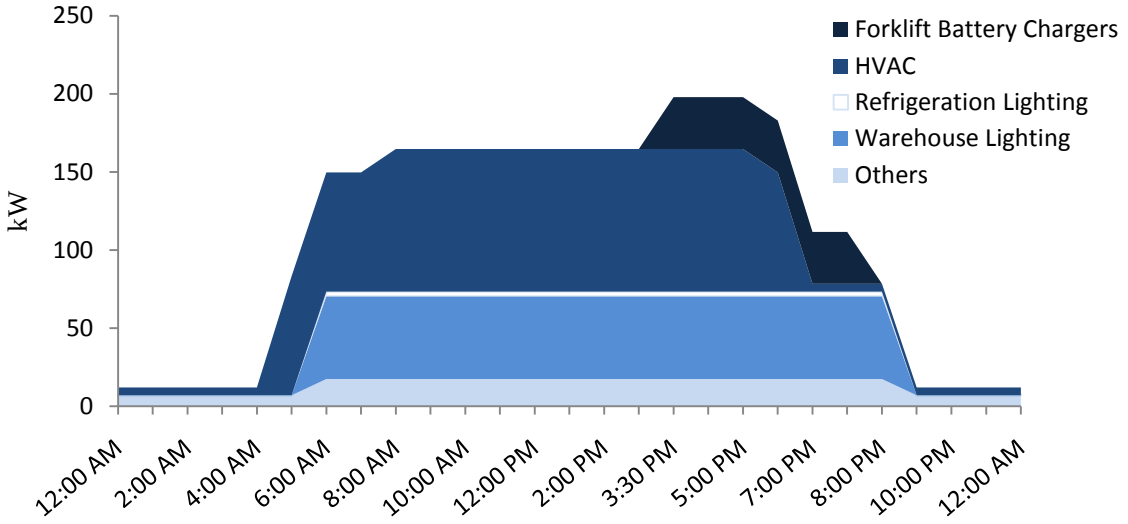


Figure 4.4. Load profile for the east electric utility meter

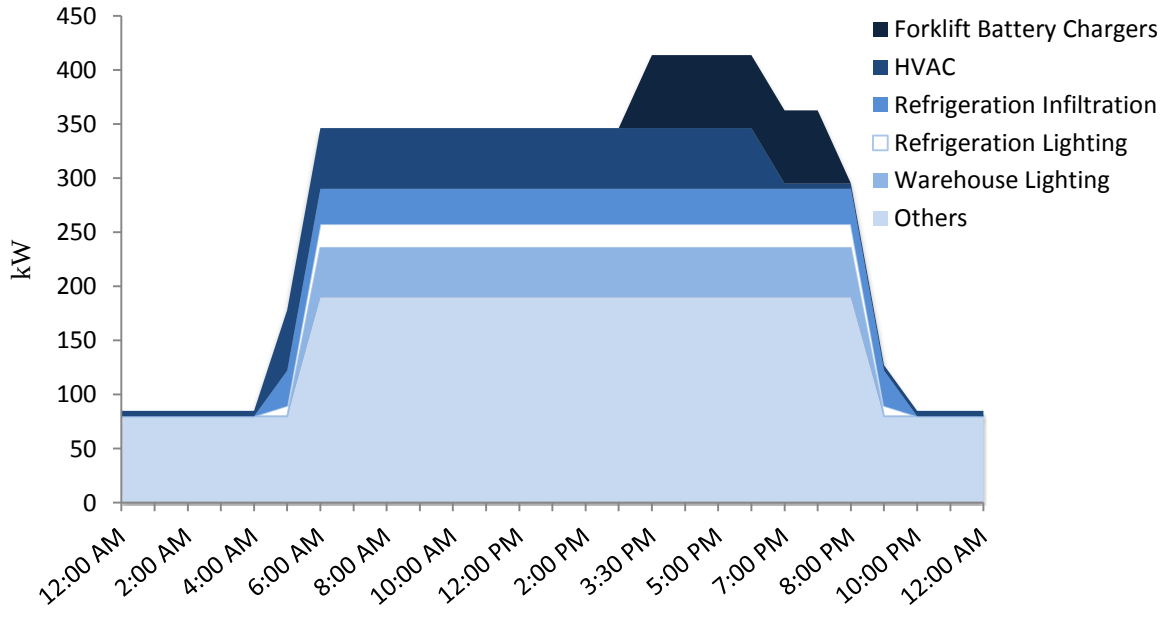


Figure 4.5. Load profile for the west electric utility meter

4.3.2 Energy and Cost Savings

This section determines the energy and cost savings for each type of audited equipment. The energy savings are determined by first identifying energy reduction solutions and calculating the change in energy consumption. The electric cost savings are determined by reducing the utility bills, for the months of November 2009 through October 2010, by the change in energy consumption and noting the price difference. This method is used to ensure the minimum monthly demand of 200 kW is not overlooked as well as the second year's facilities demand savings. The natural gas cost savings are directly calculated from the monthly energy savings. Appendix D illustrates the methodology used to calculate cost savings.

4.3.2.1 Warehouse Lighting

Lighting used throughout the warehouse has been retrofitted and currently utilizes fluorescent lamps. Due to the recent completion of the retrofit and its level of satisfaction, energy may be saved by targeting manually controlled fixtures. It has been observed and mentioned that there are occasional times when the lights in the distribution area and the north section of the high-bay area do not get turned off at the close of business. The excess usage would not affect the electric demand but would affect the electricity use.

The cost savings are calculated by increasing each month's electricity use and noting the price change. Since the lights in the staging cooler and freezer are controlled from the same switch as those in the distribution area, the east meter's excess usage is computed using the distribution area load of 11.2 kW (70 fixtures) and the staging cooler and freezer load of 3.07 kW (22 fixtures). The west meter is computed using the north high-bay load of 9.979 kW (28 fixtures). Table 4.11 shows the monthly electricity use

savings and annual cost savings for reducing excess warehouse lighting usage if the warehouse lights are left on for an average of ten hours per night twice each month.

Table 4.11. Energy and cost savings for excess warehouse lighting usage

Location	Energy Savings Electricity Use (kWh)	Cost Savings Year 1+ ($)
East Meter	285.40	144.86
West Meter	199.58	101.30

Note: Cost savings are calculated using Microsoft Excel.

4.3.2.2 Refrigeration Lighting

Presently, the walk-in refrigerator located on the west meter is equipped with metal halide lighting. By utilizing higher efficient lighting, such as LED lighting in combination with motion detection switching, a decrease in electric demand and electricity use can be realized. The energy savings is computed by recalculating the energy consumption using 120 Watt LED lighting with a 50 percent reduction in operating hours.

The 50 percent reduction in operating hours is associated with the use of motion detection switching. It is estimated from the difference of the weekly operating schedule, which is the normal operating time of the lights, and the schedule for the majority of the forklift operators, which is approximately 40 hours per week from 6:30 a.m. to 3:30 p.m. In addition, motion switching can turn the lights off after a certain period of inactivity, which can further reduce the LED's operating hours.

The cost savings is categorized into two columns to accommodate the decreased facilities demand charge during the second and subsequent years. Table 4.12 shows the monthly demand savings, weekly electricity use savings, and annual cost savings for higher efficient refrigeration lighting.

Table 4.12. Energy and cost savings for higher efficient refrigeration lighting

	Energy Savings		Cost Savings	
Location	Electric Demand & Heat Load (kW)	Electricity Use & Heat Load (kWh)	Year 1 ($)	Year 2+ ($)
West Meter				
Cooler, Cold Dock, & Freezer	17.566	1609.6	5377.43	5962.55

Note: Energy savings are calculated using Microsoft Excel. LED heat load is calculated using Calc-Rite with an assumed refrigeration run-time of 16 hours per operating day. Cost savings are calculated using Microsoft Excel.

4.3.2.3 Refrigeration Infiltration

The refrigeration doors associated with the west meter does not have any protection against infiltrating air. Two possible capital investments to reduce infiltration are full length vinyl strips and reducing the length of time the doors stay open by half. A third capital investment, dock seals, is only applicable to the cold-dock doors. All three capital investments will reduce the electric demand and the electricity use. Table 4.13 shows the annual demand savings, electricity use savings, and cost savings for reducing refrigeration infiltration.

Table 4.13. Energy and cost savings for reducing refrigeration infiltration

	Energy Savings		Cost Savings	
Capital Investment	Electric Demand (kW)	Electricity Use (kWh)	Year 1 ($)	Year 2+ ($)
Full Length Vinyl Strips	138.733	57,977.3	4071.37	4396.44
50% Duration Reduction	81.608	34,104.3	2394.95	2589.99
Dock Seals	66.369	27,826.0	2014.46	2111.98

Note: Full length vinyl strips and dock seals are calculated using a savings rate of 85% and 90%, respectively. 50% duration reduction is calculated using Calc-Rite with an assumed refrigeration run-time of 16 hours per operating day. Cost savings are calculated using Microsoft Excel.

4.3.2.4 Forklift Charging Stations

Currently, the forklift charging stations operate during peak demand times. By utilizing demand shifting, electric costs can be reduced by shifting to off-peak times. When viewing figures 4.4 and 4.5, it can be seen that the off-peak times are between 9:00 p.m. and 4:00 a.m. for the east meter and 10:00 p.m. and 4:00 a.m. for the west meter. By allowing the forklift chargers to operate during off-peak times, the electric utility bill can

be reduced by their entire electric demand requirements. Table 4.14 shows the monthly electric demand savings and annual cost savings of demand shifting for the forklift charging stations.

Table 4.14. Energy and cost savings of demand shifting for the forklift battery charging stations

	Energy Savings	Cost Savings	
Location	Electric Demand (kW)	Year 1 ($)	Year 2+ ($)
East Meter	33.216	3075.30	4148.02
West Meter	67.465	9126.25	14,886.36

Note: Cost savings are calculated using Microsoft Excel.

4.3.2.5 HVAC

There are two possible capital investments for decreasing the energy consumed by HVAC. The first investment, labeled as setup/setback (SU/SB), changes the temperature from the original SU/SB setting by increasing it ten degrees during the cooling season and decreasing it ten degrees during the heating season. The new values are a setup of 90 degrees Fahrenheit during the cooling season and a setback of 55 degrees Fahrenheit during the heating season.

The second investment, labeled as occupied set-point SU/SB, utilizes and contributes to the first investment by setting the lowest occupied cooling temperature to 76 degrees Fahrenheit and the highest occupied heating temperature to 72 degrees Fahrenheit. All original temperature settings set above 76 degrees Fahrenheit and below 72 degrees Fahrenheit are not changed. Both investments alter the electric demand, electricity use, and natural gas use. Table 4.15 shows the annual electric demand savings, electricity use savings, natural gas savings, and cost savings for changing the HVAC thermostat set-points.

Table 4.15. Energy and cost savings for HVAC

	Energy Savings			Cost Savings		
				Electric Utility		Natural Gas Utility
Location	Electric Demand (kW)	Electricity Use (kWh)	Natural Gas Use (ccf)	Year 1 ($)	Year 2+ ($)	Year 1+ ($)
East Meter						
SU/SB	1.4	8530	2638	379.80	347.30	3529.90
Occ. Setpoint & SU/SB	94.5	27,428	2916	1921.67	1921.67	3813.03
West Meter						
SU/SB	-2.2	3600	1463	129.60	129.60	2274.50
Occ. Setpoint & SU/SB	29.2	8600	1359	730.70	828.22	2166.02

Note: Energy savings are calculated using e-QUEST. Cost savings are calculated using Microsoft Excel.

4.3.2.6 Summary

To summarize the cost savings, a table is created to display the savings for both the first year and the second and subsequent years. The data is displayed for each energy cost reducing opportunity and as a total. Table 4.16 shows the summarized energy cost savings.

Table 4.16. Cost savings summary

Energy Cost Reduction Opportunity	Year 1 ($)	Year 2+ ($)
Warehouse Lighting - East Meter	144.86	144.86
Warehouse Lighting - West Meter	101.30	101.30
Refrigeration Lighting Upgrade	5377.43	5962.55
Refrigeration Infiltration - Full Length Vinyl Strips	4071.37	4396.44
Refrigeration Infiltration - 50% Reduction	2394.95	2589.99
Refrigeration Infiltration - Dock Seals	2014.46	2111.98
Forklift Charging Stations - East Meter	3075.30	4148.02
Forklift Charging Stations - West Meter	9126.25	14,886.36
HVAC SU/SB - East Meter	3908.90	3877.20
HVAC Occupied SU/SB - East Meter	3659.50	3659.50
HVAC SU/SB - West Meter	5451.57	5451.57
HVAC Occupied SU/SB - West Meter	4260.60	4358.12
TOTAL	43,586.49	51,687.89

4.4 Economic Analysis

The economic analysis for each type of audited equipment consists of the capital investment cost and financial measures. The cost of the capital investment includes

procurement cost, installation cost, and maintenance cost. Operation cost is estimated as minimal and is excluded. The financial measures used are SPP and IRR.

4.4.1 Warehouse Lighting

A capital investment that supports reducing excess warehouse lighting usage is a programmable wall switch. It utilizes a user-defined preset timer to electronically switch the on/off cycle and has an estimated total procurement cost of $100.00 per unit. Its installation cost is estimated using an installation time of one hour per switch and one laborer with a gross hourly wage of $45.00. Maintenance costs are estimated to be minimal and are excluded from the total cost. Table 4.17 shows the total cost, SPP, and IRR for the capital investment of a programmable wall switch.

Table 4.17. Total cost, SPP, and IRR for warehouse lighting

Location	Total Cost ($)	SPP (year)	IRR (%)
East Meter	725.00	5.0	15.07
West Meter	290.00	2.9	32.90

Note: The first year cost savings is used in the SPP calculation and an estimated expected life of 10 years is used to calculate IRR.

4.4.2 Refrigeration Lighting

As mentioned in 4.3.2.2, the capital investment that supports higher efficient refrigeration lighting is LED lighting. The total estimated procurement cost for LED lighting is $1050.00 per unit. The installation cost is estimated using an installation time of one hour per unit and three laborers with a gross hourly wage of $45.00 each. The maintenance cost reduces the total cost because unlike MH lamps, LED lamps do not require replacement every five years. The reduced maintenance cost is estimated using three lamp replacements for all 27 lamps over the LED's 15 year expected life. Each lamp replacement is estimated using one-half hour per lamp and one laborer with a gross

hourly rate of $45.00. Table 4.18 shows the total cost, SPP, and IRR for the capital investment of LED lighting.

Table 4.18. Total cost, SPP, and IRR for refrigeration lighting

Location	Total Cost ($)	SPP (year)	IRR (%)
West Meter	30,172.50	5.6	17.77

Note: The first year cost savings is used in the SPP calculation and an estimated expected life of 15 years is used to calculate IRR.

4.4.3 Refrigeration Infiltration

As mentioned in 4.3.2.3, capital investments that support the reduction of refrigeration infiltration is full length vinyl strips, reducing how long the doors stay open by 50 percent, and dock seals. The estimated procurement cost for the full length vinyl strips is $600.00 per unit, dock seals is $705.00 per unit, and 50 percent duration reduction is zero. The installation costs are estimated using a gross hourly wage of $45.00 per laborer for all three investments and three laborers for the vinyl strips, two laborers for the 50 percent duration reduction, and three laborers for the dock seals. The estimated installation time is two hours per unit for the vinyl strips, four hours per unit for the 50 percent duration reduction, and four hours per unit for the dock seals. Table 4.19 shows the total cost, SPP, and IRR for all three capital investments for reducing refrigeration infiltration.

Table 4.19. Total cost, SPP, and IRR for refrigeration infiltration

Location	Total Cost ($)	SPP (year)	IRR (%)
West Meter			
Full Length Vinyl Strips	3480.00	0.9	121.22
50% Duration Reduction	1440.00	0.6	171.31
Dock Seals	2490.00	1.2	83.03

Note: The first year cost savings is used in the SPP calculation and an estimated expected life of 15 years is used to calculate IRR.

4.4.4 Forklift Charging Stations

Three solutions that are suitable of supporting demand shifting have been considered. The first solution is the replacement of the current battery chargers with a model that is capable of a delayed or programmable start. The second solution is a 480 volt programmable timer; however, the author failed to locate a timer that contains a contact/load voltage of 480 volts. If one could be found, then it would certainly be a lesser expensive capital investment. The third solution is manually turning on the chargers before the building is vacated. However, since the demand charge is calculated from the largest 30 minute interval, the chargers could not be turned on until at least 30 minutes after all equipment is turned off.

The selected capital investment of supporting demand shifting is the replacement battery chargers with the delayed start capability. The replacement chargers consume approximately the same energy as the current chargers and their estimated procurement cost is $1500.00 per single-phase unit and $2000.00 per three-phase unit. Their installation cost is estimated using an installation time of one-half hour per unit and two laborers with a gross hourly wage of $45.00 each. Maintenance costs are estimated to be minimal and are excluded from the total cost. Table 4.20 shows the total cost, SPP, and IRR for the capital investment of the replacement battery chargers.

Table 4.20. Total cost, SPP, and IRR for the forklift charging stations

Location	Total Cost ($)	SPP (year)	IRR (%)
East Meter	19,540.00	6.4	19.75
West Meter	17,905.00	2.0	69.90

Note: The first year cost savings is used in the SPP calculation and an estimated expected life of 20 years is used to calculate IRR.

4.4.5 HVAC

As mentioned in 4.3.2.5, capital investments that support changing thermostat set-points is SU/SB and occupied set-point SU/SB. The only costs associated with both

investments are labeled as installation costs and involve reprogramming the thermostat set-points. The installation cost is estimated using an installation time of one-half hour per zone and one laborer with a gross hourly wage of $45.00. For the carrier proprietary thermostats, an exception of $90.00 per hour and an installation time of two hours are used to accommodate professional services. Table 4.21 shows the total cost, SPP, and IRR for both capital investments of changing thermostat set-points.

Table 4.21. Total cost, SPP, and IRR for HVAC

Location	Total Cost ($)	SPP (year)	IRR (%)
East Meter			
SU/SB	247.50	0.06	1578.89
Occ. Setpoint SU/SB	247.50	0.04	2317.05
West Meter			
SU/SB	270.00	0.11	890.40
Occ. Setpoint SU/SB	270.00	0.09	1075.93

Note: The first year cost savings is used in the SPP calculation and an estimated expected life of 5 years is used to calculate IRR.

4.4.6 Summary

To summarize the economic analysis of the audited equipment, a table is developed and ranked from most favorable to least favorable by IRR. SPP and the required investment amount are listed as well as the associated capital investment. Table 4.22 summarizes the economic analysis for all of the audited equipment.

Table 4.22. Economic analysis summary

Rank	Capital Investment	Location	Investment ($)	SPP (year)	IRR (%)
1A	Occupied Setpoint & SU/SB	East Building HVAC Zones	247.50	0.04	2317.05
1B	Setup/Setback	East Building HVAC Zones	247.50	0.06	1578.89
2A	Occupied Setpoint & SU/SB	West Building HVAC Zones	270.00	0.09	1075.93
2B	Setup/Setback	West Building HVAC Zones	270.00	0.11	890.40
3	50% Duration Reduction	West Building Refrigeration Doors	1440.00	0.60	171.31
4	Full Length Vinyl Strips	West Building Refrigeration Doors	3480.00	0.90	121.22
5	Dock Seals	West Building Cold Dock Doors	2490.00	1.20	83.03
6	Replacement Forklift Chargers	West Building High-Bay Station	17,905.00	2.00	69.90
7	Programmable Wall Switch	West Building North High-Bay Lights	290.00	2.90	32.90
8	Replacement Forklift Chargers	East Building Low-Bay Station	19,540.00	6.40	19.75
9	LED Lighting	West Building Refrigeration Lights	30,172.50	5.60	17.77
10	Programmable Wall Switch	East Building Distribution & Staging Lights	725.00	5.00	15.07

5.0 SUGGESTIONS FOR ADDITIONAL WORK

Although the current list of energy cost reducing opportunities and their associated capital investments, as portrayed in table 4.22, for the most part contains favorable economic investment criteria, it is recognized that other aspects, both within and outside the scope of this project, might be just as favorable. If a lesser expensive solution were identified for shifting the forklift battery chargers to off-peak times, then their investment criteria would certainly excel from the current ranking. This would also hold true for any and all other currently stated solutions, as this is a culmination of one mind, there is certainly expansive room for idea creation and implementation.

Other possible identifiable opportunities can be looked into and analyzed. Most of Harvesters' waste disposal is estimated as being organic. A solution to aid in its separation could prove beneficial. Another possibility concerns Harvesters' trucking fleet. A logistics program that aids in the reduction of their fuel consumption and delivery time could be considered. The third item relates to the identification and evaluation of energy cost reducing opportunities at Harvesters' Topeka, Kansas location.

An ultimate solution to the identification and evaluation of energy cost reducing opportunities is the dynamic management of energy. A benefit of an energy management system is it would allow Harvesters to manage their electric demand by specifying an upper and lower limit. It would also allow the programming of an operation schedule which would help manage their electricity use. The feasibility of an energy management system should be considered.

One last suggestion for additional work concerns the currently identified and evaluated energy cost reducing opportunities. Since Harvesters is a non-profit

organization, a donation fund could be started and managed for the purpose of acquiring either monetary or equipment donations for the implementation of the currently defined opportunities and their associated capital investments. This would certainly result in a zero year SPP, an infinite IRR, and an extra five meals for every dollar saved through the cost reduction of energy.

References

Angevine, Eric Neil, and Jennifer S. Fair. 2007. HVAC Systems. In *Energy Management Handbook. 6th ed.,* ed. Wayne C. Turner and Steve Doty, 247-272. Lilburn: The Fairmont Press.

Beggs, Clive. 2002. Energy: Management, Supply and Conservation. Oxford: Butterworth-Heinemann.

Bowers, Norm. 2010a. E-mail message to author. November 16.

———. 2010b. E-mail message to author. December 2.

Capehart, Barney L., Mark B. Spiller, and Scott Frazier. 2007. Energy Auditing. In *Energy Management Handbook. 6th ed.,* ed. Wayne C. Turner and Steve Doty, 23-39. Lilburn: The Fairmont Press.

Capehart, Barney L., Wayne C. Turner, and William J. Kennedy. 2008. Guide to Energy Management. 6th ed. Lilburn: The Fairmont Press.

Conard, John. 2010. Energy Management. Course in Engineering Management, The University of Kansas Edwards Campus, Overland Park, KS, Fall Semester.

Doty, Steve. 2008. Commercial Energy Auditing Reference Handbook. Lilburn: The Fairmont Press.

Global Equipment Company Inc. Energy Saving Dock Seal. http://www.globalindustrial.com/p/material-handling/dock-truck/dock-seals-shelters-roll-up-doors/black-dock-seal-40-ounce-8-w-x-10-h-hd-wear-pleats (accessed February 14, 2011).

———. Scratch Resistant Strip Door Curtain. http://www.globalindustrial.com/p/material-handling/dock-truck/doors-strip/scratch-resistant-strip-door-curtain-9-w-x-13-h (accessed February 14, 2011).

Harvesters – The Community Food Network. http://harvesters.org/ (accessed September 15, 2010 – December 30, 2010).

———. 2010a. 2010 Annual Report. http://harvesters.org/_FileLibrary/FileImage/2010HarvARFinalFullReport.pdf (accessed December 28, 2010).

———. 2010b. Strategic Plan, Fiscal Years 2011 - 2016. http://harvesters.org/_FileLibrary/FileImage/StrategicPlanJuly2010.pdf (accessed September 28, 2010).

Hirsch, Jeff. DOE-2.com Home Page. James J. Hirsch. http://www.doe2.com/ (accessed January 13, 2011).

KCPL. 2009. Large General Service. http://www.kcpl.com/about/MORates/Sched11.pdf (accessed November 29, 2010).

Krarti, Moncef. 2000. Energy Audit of Building Systems: An Engineering Approach. Boca Raton: CRC Press.

MGE. 2010. Large General Gas Service. http://d352119.win159.gsi-host.net/Tariffs/TFLargeGeneralGasService.pdf (accessed November 30, 2010).

Midwest Power Industries Inc. Forklift Battery Chargers. http://www.forkliftbatteriesandchargers.com/ForkliftBatteryChargers.php (accessed December 8, 2011).

National Refrigeration & Air Conditioning Canada Corp. KeepRite Calc-Rite. http://www.keepriterefrigeration.com/calcrite/RTcalc1.htm (accessed January 19, 2011).

NOAA. National Weather Service Climate. http://www.weather.gov/climate/index.php?wfo=eax (accessed February 5, 2011).

Norman Lamps Inc. High Bay LEDs. http://www.normanleds.com/highbay-led.html (accessed February 14, 2011).

Pratt, David. 2007. Economic Analysis. In *Energy Management Handbook. 6th ed.*, ed. Wayne C. Turner and Steve Doty, 41-86. Lilburn: The Fairmont Press.

Stoecker, Wilbert F. 1998. Industrial Refrigeration Handbook. New York: The McGraw Hill Companies.

Thumann, Albert, and D. Paul Mehta. 2008. Handbook of Energy Engineering. 6th ed. Lilburn: The Fairmont Press.

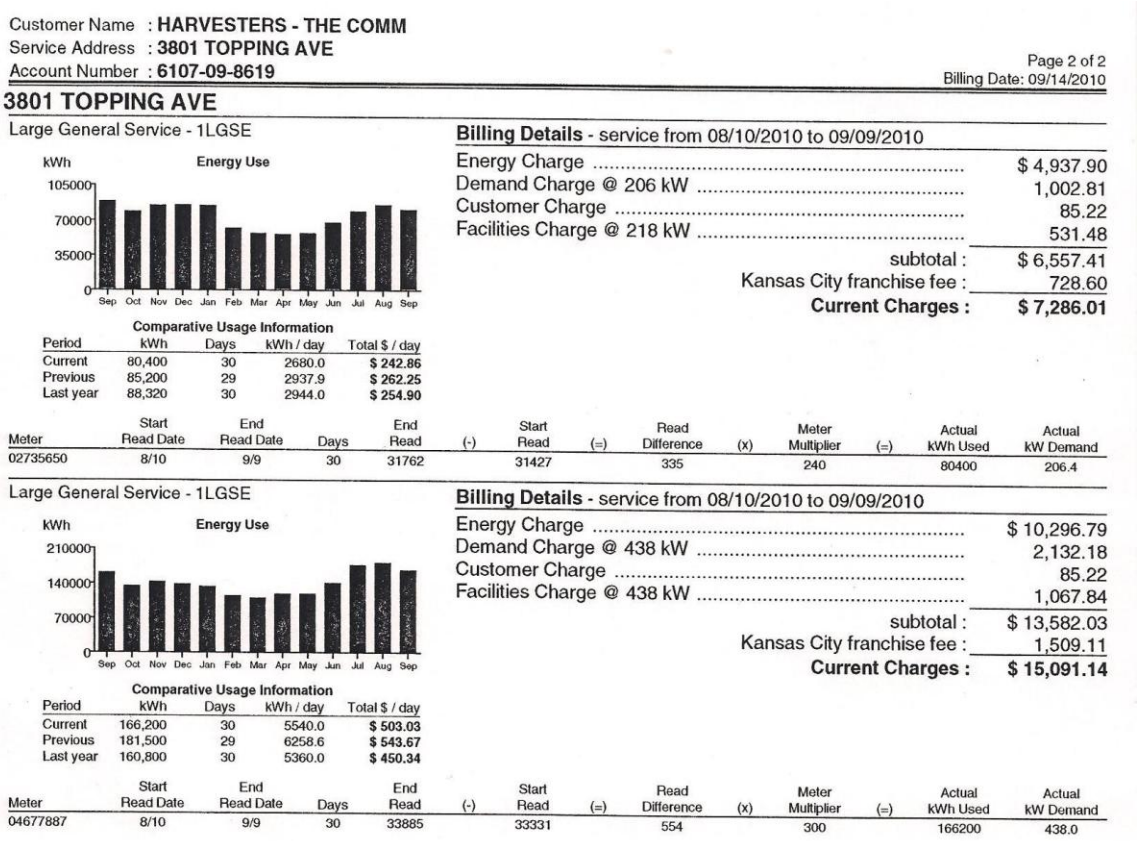
Thumann, Albert, and William J. Younger. 2008. Handbook of Energy Audits. 7th ed. Lilburn: The Fairmont Press.

Woodroof, Eric A., and John Fetters. 2007. Lighting. In *Energy Management Handbook. 6th ed.*, ed. Wayne C. Turner and Steve Doty, 353-400. Lilburn: The Fairmont Press.

W.W. Grainger Inc. Plug-in & Wall Switch Timers. http://www.grainger.com/Grainger/INTERMATIC-Timer-4XGV7?Pid=search (accessed February 10, 2011).

Appendix A

Electric Billing Statement and Rate Structure



Customer Name : **HARVESTERS - THE COMM**
Service Address : **3801 TOPPING AVE**
Account Number : **6107-09-8619**

Page 2 of 2
Billing Date: 09/14/2010

3801 TOPPING AVE

Large General Service - 1LGSE

kWh — Energy Use

105000
70000
35000
0
Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep

Comparative Usage Information

Period	kWh	Days	kWh / day	Total $ / day
Current	80,400	30	2680.0	**$ 242.86**
Previous	85,200	29	2937.9	**$ 262.25**
Last year	88,320	30	2944.0	**$ 254.90**

Billing Details - service from 08/10/2010 to 09/09/2010

Energy Charge	$ 4,937.90
Demand Charge @ 206 kW	1,002.81
Customer Charge	85.22
Facilities Charge @ 218 kW	531.48
subtotal :	$ 6,557.41
Kansas City franchise fee :	728.60
Current Charges :	**$ 7,286.01**

Meter	Start Read Date	End Read Date	Days	End Read	(-)	Start Read	(=)	Read Difference	(x)	Meter Multiplier	(=)	Actual kWh Used	Actual kW Demand
02735650	8/10	9/9	30	31762		31427		335		240		80400	206.4

Large General Service - 1LGSE

kWh — Energy Use

210000
140000
70000
0
Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep

Comparative Usage Information

Period	kWh	Days	kWh / day	Total $ / day
Current	166,200	30	5540.0	**$ 503.03**
Previous	181,500	29	6258.6	**$ 543.67**
Last year	160,800	30	5360.0	**$ 450.34**

Billing Details - service from 08/10/2010 to 09/09/2010

Energy Charge	$ 10,296.79
Demand Charge @ 438 kW	2,132.18
Customer Charge	85.22
Facilities Charge @ 438 kW	1,067.84
subtotal :	$ 13,582.03
Kansas City franchise fee :	1,509.11
Current Charges :	**$ 15,091.14**

Meter	Start Read Date	End Read Date	Days	End Read	(-)	Start Read	(=)	Read Difference	(x)	Meter Multiplier	(=)	Actual kWh Used	Actual kW Demand
04677887	8/10	9/9	30	33885		33331		554		300		166200	438.0

Figure A.1. Electric billing statement for September 2010
Source: Billing statement from Norm Bowers, November 23, 2010, hardcopy given to author

KANSAS CITY POWER & LIGHT COMPANY

P.S.C. MO. No. 7 Fifth ☐ Original ☒ Revised Sheet No. 11A

Cancelling P.S.C. MO. No. 7 Fourth ☐ Original ☒ Revised Sheet No. 11A

For Missouri Retail Service Area

LARGE GENERAL SERVICE
Schedule LGS
(Continued)

RATE FOR SERVICE AT SECONDARY VOLTAGE:

A. CUSTOMER CHARGE:
Customer pays one of the following charges per month based upon the Facilities Demand:

0-24 kW	$85.22
25-199 kW	$85.22
200-999 kW	$85.22
1000 kW or above	$727.61

ADDITIONAL METER CHARGE (FROZEN):
Separately metered space heat: $1.96

B. FACILITIES CHARGE:

Per kW of Facilities Demand per month $2.438

C. DEMAND CHARGE:

	Summer Season	Winter Season
Per kW of Billing Demand per month	$4.868	$2.620

D. ENERGY CHARGE:

	Summer Season	Winter Season
First 180 Hours Use per month:	$0.0715 per kWh	$0.0657 per kWh
Next 180 Hours Use per month:	$0.0545 per kWh	$0.0419 per kWh
Over 360 Hours Use per month:	$0.0426 per kWh	$0.0358 per kWh

E. SEPARATELY METERED SPACE HEAT (FROZEN):
When the customer has separately metered electric space heating equipment of a size and design approved by the Company, the kWh used for electric space heating shall be billed as follows:

(i) Applicable during the Winter Season:

$0.0442 per kWh per month.

(ii) Applicable during the Summer Season:

The demand established and energy used by equipment connected to the space heating circuit will be added to the demands and energy measured for billing under the rates above and for the determination of the Minimum Monthly Bill.

DATE OF ISSUE: July 8, 2009
ISSUED BY: Curtis D. Blanc, Sr. Director

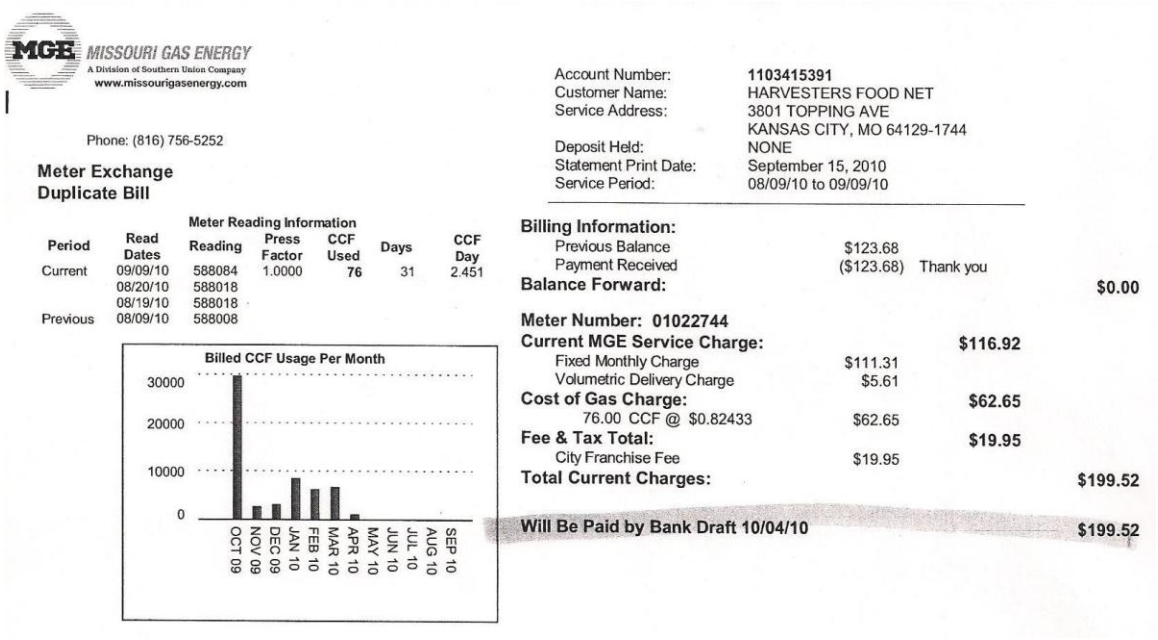
DATE EFFECTIVE: September 1, 2009
1201 Walnut, Kansas City, Mo. 64106

FILED
Missouri Public
Service Commission
ER-2009-0089; JE-2010-0014

Figure A.2. KCPL LGS rate structure
Source: Rate structure from KCPL 2009, 2.

Appendix B

Natural Gas Billing Statement and Rate Structure



MISSOURI GAS ENERGY
A Division of Southern Union Company
www.missourigasenergy.com

Phone: (816) 756-5252

Meter Exchange
Duplicate Bill

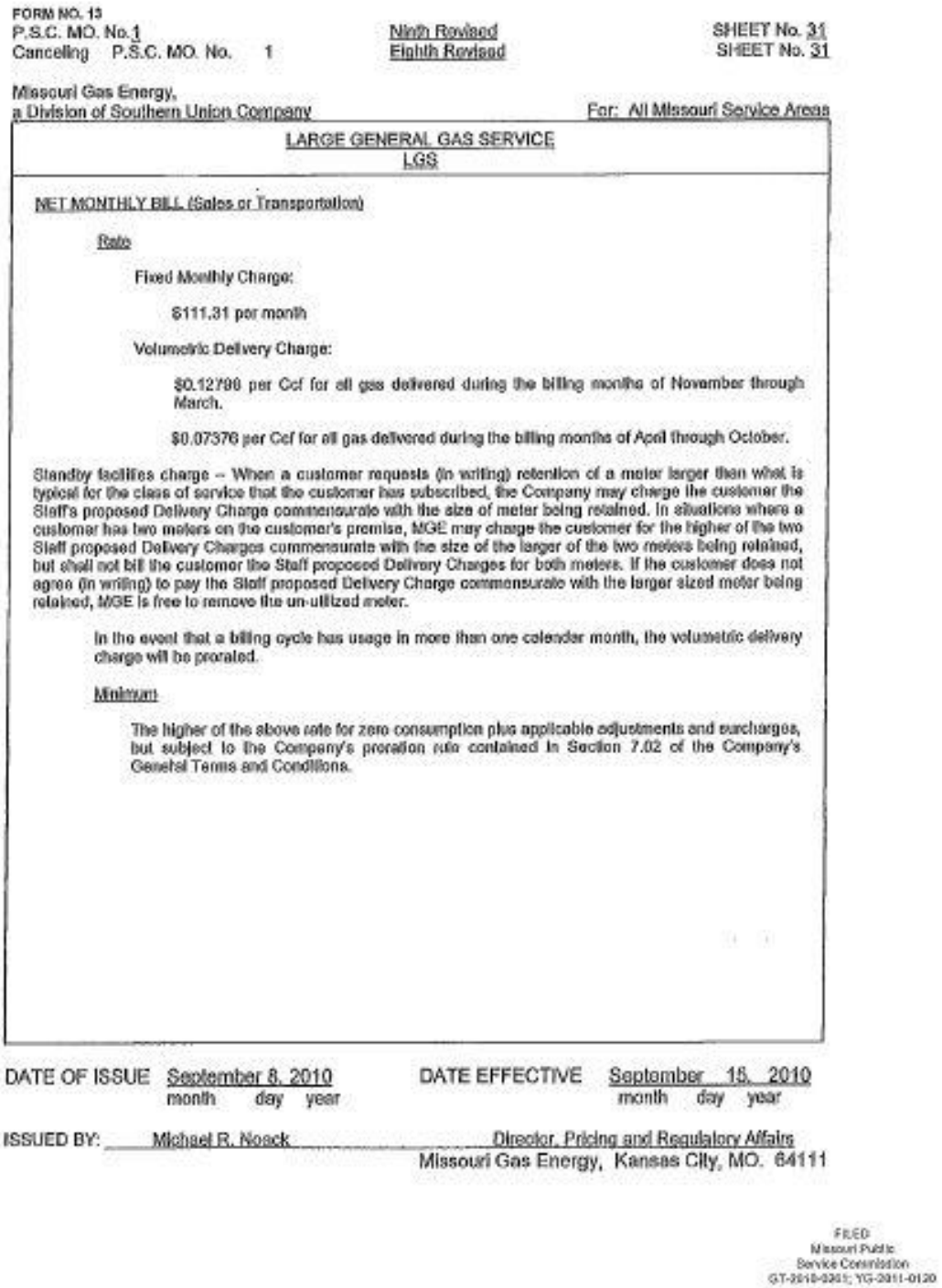
Meter Reading Information

Period	Read Dates	Reading	Press Factor	CCF Used	Days	CCF Day
Current	09/09/10	588084	1.0000	76	31	2.451
	08/20/10	588018				
	08/19/10	588018				
Previous	08/09/10	588008				

Billed CCF Usage Per Month

Account Number:	**1103415391**		
Customer Name:	HARVESTERS FOOD NET		
Service Address:	3801 TOPPING AVE KANSAS CITY, MO 64129-1744		
Deposit Held:	NONE		
Statement Print Date:	September 15, 2010		
Service Period:	08/09/10 to 09/09/10		
Billing Information:			
Previous Balance	$123.68		
Payment Received	($123.68)	Thank you	
Balance Forward:			**$0.00**
Meter Number: 01022744			
Current MGE Service Charge:		**$116.92**	
Fixed Monthly Charge	$111.31		
Volumetric Delivery Charge	$5.61		
Cost of Gas Charge:		**$62.65**	
76.00 CCF @ $0.82433	$62.65		
Fee & Tax Total:		**$19.95**	
City Franchise Fee	$19.95		
Total Current Charges:			**$199.52**
Will Be Paid by Bank Draft 10/04/10			**$199.52**

Figure B.1. Natural gas billing statement for September 2010
Source: Billing statement from Norm Bowers, November 23, 2010, hardcopy given to author



FORM NO. 13
P.S.C. MO. No. 1 — Ninth Revised — SHEET No. 31
Cancelling P.S.C. MO. No. 1 — Eighth Revised — SHEET No. 31

Missouri Gas Energy,
a Division of Southern Union Company — For: All Missouri Service Areas

LARGE GENERAL GAS SERVICE
LGS

NET MONTHLY BILL (Sales or Transportation)

Rate

Fixed Monthly Charge:

$111.31 per month

Volumetric Delivery Charge:

$0.12798 per Ccf for all gas delivered during the billing months of November through March.

$0.07376 per Ccf for all gas delivered during the billing months of April through October.

Standby facilities charge -- When a customer requests (in writing) retention of a meter larger than what is typical for the class of service that the customer has subscribed, the Company may charge the customer the Staff's proposed Delivery Charge commensurate with the size of meter being retained. In situations where a customer has two meters on the customer's premise, MGE may charge the customer for the higher of the two Staff proposed Delivery Charges commensurate with the size of the larger of the two meters being retained, but shall not bill the customer the Staff proposed Delivery Charges for both meters. If the customer does not agree (in writing) to pay the Staff proposed Delivery Charge commensurate with the larger sized meter being retained, MGE is free to remove the un-utilized meter.

In the event that a billing cycle has usage in more than one calendar month, the volumetric delivery charge will be prorated.

Minimum

The higher of the above rate for zero consumption plus applicable adjustments and surcharges, but subject to the Company's proration rule contained in Section 7.02 of the Company's General Terms and Conditions.

DATE OF ISSUE September 8, 2010 (month day year) — DATE EFFECTIVE September 18, 2010 (month day year)

ISSUED BY: Michael R. Noack — Director, Pricing and Regulatory Affairs
Missouri Gas Energy, Kansas City, MO. 64111

FILED
Missouri Public
Service Commission
GT-2010-0363; YG-2011-0120

Figure B.2. MGE LGS rate structure
Source: Rate structure from MGE 2010, 4.

Appendix C

e-QUEST Model of Harvesters' Building

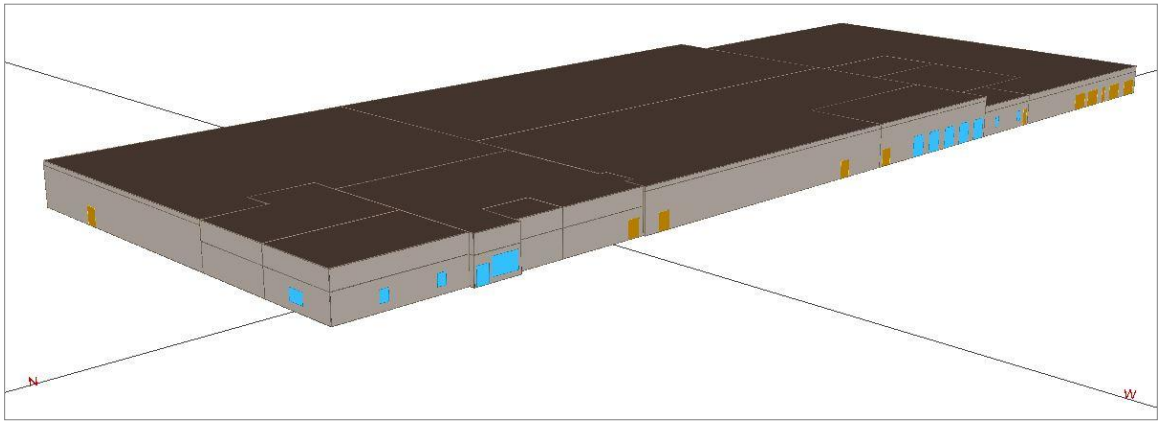


Figure C.1. e-QUEST Model of Harvesters' east-metered building
Source: Model from e-QUEST v.3.64 output file of author-defined inputs

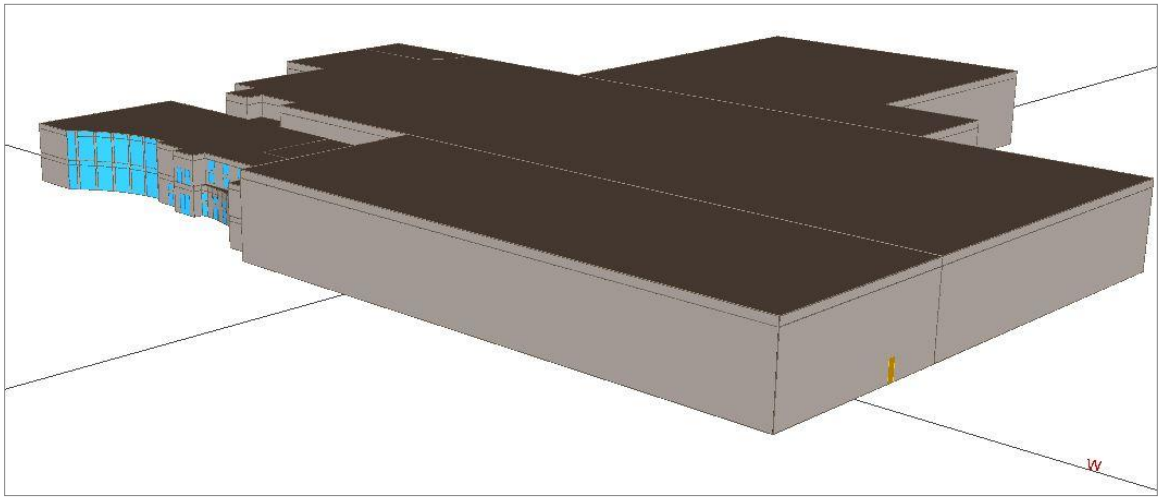


Figure C.2. e-QUEST Model of Harvesters' west-metered building
Source: Model from e-QUEST v.3.64 output file of author-defined inputs

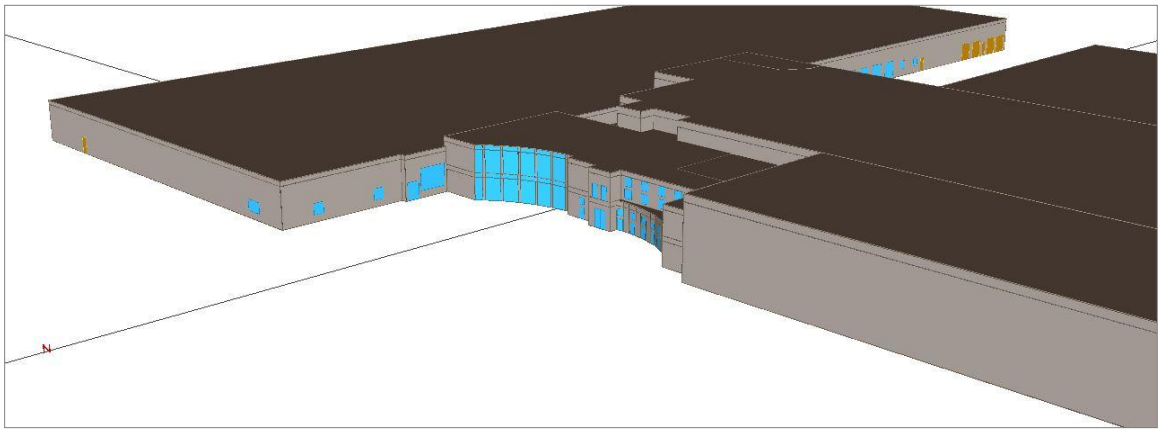


Figure C.3. e-QUEST Model of Harvesters' complete building
Source: Model from e-QUEST v.3.64 output file of author-defined inputs

Appendix D

Cost Savings Calculation Methodology

Cost savings are calculated by re-creating the utility bills and altering the electric demand, electricity use, and natural gas use by the energy savings calculated for each potential capital investment. With the exception of figures D.1 and D.2, the figures in this appendix illustrate how the calculations are computed for each audited equipment and their potential capital investments. Figure D.1 and D.2 shows the electric utility rate schedule and natural gas rate schedule, respectively, which is used in the cost savings calculation.

Rate Schedule	Summer	Winter
Demand Cost	$ 4.8680	$ 2.6200
Facilities Cost	$ 2.4380	$ 2.4380
Energy Use Cost (first 180 hrs)	$ 0.0715	$ 0.0657
Energy Use Cost (next 180 hrs)	$ 0.0545	$ 0.0419
Energy Use Cost (over 360 hrs)	$ 0.0426	$ 0.0358

Figure D.1. Electric utility rate schedule used in cost savings calculation

Rate Schedule	Summer	Winter
Service Charge	$ 111.31	$ 111.31
Volumetric Delivery Charge	$ 0.07376	$ 0.12798
Usage Charge	$ 0.82433	$ 0.82433

Figure D.2. Natural gas utility rate schedule used in cost savings calculation

Current Cost - East Meter		Jan 2010	Feb 2010	Mar 2010	Apr 2010	May 2010	June 2010	July 2010	Aug 2010	Sept 2010	Oct 2010	Nov 2009	Dec 2009
Facilities Demand	kW	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00
Monthly Demand	kW	189.60	151.20	132.00	141.60	151.20	189.60	201.60	206.40	206.40	177.60	184.80	189.60
Energy Use	kWh	84,480.00	61,920.00	57,120.00	55,920.00	56,880.00	67,440.00	78,720.00	85,200.00	80,400.00	64,080.00	84,480.00	84,960.00
Hours Use	hours	445.57	409.52	432.73	394.92	376.19	355.70	390.48	412.79	389.53	360.81	457.14	448.10
FAC Charge		$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23
Demand Charge		$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 973.60	$ 981.39	$ 1,004.76	$ 1,004.76	$ 524.00	$ 524.00	$ 524.00
Energy Charge		$ 4,252.99	$ 3,196.51	$ 2,900.26	$ 2,919.50	$ 3,016.08	$ 4,265.37	$ 4,834.02	$ 5,145.32	$ 4,940.84	$ 3,444.91	$ 4,221.89	$ 4,270.18
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 5,364.44	$ 4,307.96	$ 4,011.70	$ 4,030.95	$ 4,127.53	$ 5,826.41	$ 6,402.86	$ 6,737.52	$ 6,533.04	$ 4,556.36	$ 5,333.34	$ 5,381.62
KC Franchise Fee		$ 596.05	$ 478.66	$ 445.74	$ 447.88	$ 458.61	$ 647.38	$ 711.43	$ 748.61	$ 725.89	$ 506.26	$ 592.59	$ 597.96
Total Cost		**$ 5,960.49**	**$ 4,786.62**	**$ 4,457.45**	**$ 4,478.84**	**$ 4,586.14**	**$ 6,473.79**	**$ 7,114.29**	**$ 7,486.14**	**$ 7,258.94**	**$ 5,062.62**	**$ 5,925.93**	**$ 5,979.58**
East Meter (+285.4 kWh)		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00
Monthly Demand	kW	189.60	151.20	132.00	141.60	151.20	189.60	201.60	206.40	206.40	177.60	184.80	189.60
Energy Use	kWh	84,765.40	62,205.40	57,405.40	56,205.40	57,165.40	67,725.40	79,005.40	85,485.40	80,685.40	64,365.40	84,765.40	85,245.40
Hours Use	hours	447.07	411.41	434.89	396.93	378.08	357.20	391.89	414.17	390.92	362.42	458.69	449.61
FAC Charge		$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23
Demand Charge		$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 973.60	$ 981.39	$ 1,004.76	$ 1,004.76	$ 524.00	$ 524.00	$ 524.00
Energy Charge		$ 4,263.21	$ 3,206.73	$ 2,910.47	$ 2,929.72	$ 3,026.30	$ 4,277.52	$ 4,846.18	$ 5,157.48	$ 4,953.00	$ 3,455.13	$ 4,232.11	$ 4,280.39
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 5,374.66	$ 4,318.18	$ 4,021.92	$ 4,041.17	$ 4,137.75	$ 5,838.57	$ 6,415.02	$ 6,749.68	$ 6,545.20	$ 4,566.58	$ 5,343.55	$ 5,391.84
KC Franchise Fee		$ 597.18	$ 479.80	$ 446.88	$ 449.02	$ 459.75	$ 648.73	$ 712.78	$ 749.96	$ 727.24	$ 507.40	$ 593.73	$ 599.09
Total Cost		**$ 5,971.84**	**$ 4,797.97**	**$ 4,468.80**	**$ 4,490.19**	**$ 4,597.49**	**$ 6,487.30**	**$ 7,127.80**	**$ 7,499.65**	**$ 7,272.45**	**$ 5,073.97**	**$ 5,937.28**	**$ 5,990.93**
Total Savings	**$ (144.86)**	**$ (11.35)**	**$ (11.35)**	**$ (11.35)**	**$ (11.35)**	**$ (11.35)**	**$ (13.51)**	**$ (13.51)**	**$ (13.51)**	**$ (13.51)**	**$ (11.35)**	**$ (11.35)**	**$ (11.35)**

Figure D.3. Warehouse lighting east meter cost savings calculation

Figure D.4. Warehouse lighting west meter cost savings calculation

Current Cost - West Meter		Jan 2010	Feb 2010	Mar 2010	Apr 2010	May 2010	June 2010	July 2010	Aug 2010	Sept 2010	Oct 2010	Nov 2009	Dec 2009
Facilities Demand	kW	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00
Monthly Demand	kW	303.00	297.00	270.00	318.00	324.00	408.00	423.00	435.00	438.00	393.00	366.00	357.00
Energy Use	kWh	133,200.00	114,300.00	109,800.00	118,200.00	117,600.00	140,700.00	176,100.00	181,500.00	166,200.00	138,900.00	141,900.00	137,400.00
Hours Use	hours	439.60	384.85	406.67	371.70	362.96	344.85	416.31	417.24	379.45	353.44	387.70	384.87
FAC Charge		$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84
Demand Charge		$ 793.86	$ 778.14	$ 707.40	$ 833.16	$ 848.88	$ 1,986.14	$ 2,059.16	$ 2,117.58	$ 2,132.18	$ 1,029.66	$ 958.92	$ 935.34
Energy Charge		$ 6,732.00	$ 6,016.50	$ 5,680.44	$ 6,292.20	$ 6,309.60	$ 8,990.17	$ 10,608.37	$ 10,926.54	$ 10,296.79	$ 7,519.26	$ 7,451.70	$ 7,232.28
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,678.92	$ 7,947.70	$ 7,540.90	$ 8,278.42	$ 8,311.54	$ 12,129.38	$ 13,820.60	$ 14,197.18	$ 13,582.04	$ 9,701.98	$ 9,563.68	$ 9,320.68
KC Franchise Fee		$ 964.32	$ 883.08	$ 837.88	$ 919.82	$ 923.50	$ 1,347.71	$ 1,535.62	$ 1,577.46	$ 1,509.12	$ 1,078.00	$ 1,062.63	$ 1,035.63
Total Cost		**$ 9,643.25**	**$ 8,830.78**	**$ 8,378.78**	**$ 9,198.25**	**$ 9,235.05**	**$ 13,477.09**	**$ 15,356.22**	**$ 15,774.65**	**$ 15,091.16**	**$ 10,779.98**	**$ 10,626.32**	**$ 10,356.32**
West Meter (+199.58 kWh)		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00
Monthly Demand	kW	303.00	297.00	270.00	318.00	324.00	408.00	423.00	435.00	438.00	393.00	366.00	357.00
Energy Use	kWh	133,399.58	114,499.58	109,999.58	118,399.58	117,799.58	140,899.58	176,299.58	181,699.58	166,399.58	139,099.58	142,099.58	137,599.58
Hours Use	hours	440.26	385.52	407.41	372.33	363.58	345.34	416.78	417.70	379.91	353.94	388.25	385.43
FAC Charge		$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84
Demand Charge		$ 793.86	$ 778.14	$ 707.40	$ 833.16	$ 848.88	$ 1,986.14	$ 2,059.16	$ 2,117.58	$ 2,132.18	$ 1,029.66	$ 958.92	$ 935.34
Energy Charge		$ 6,739.14	$ 6,023.64	$ 5,687.58	$ 6,299.34	$ 6,316.74	$ 8,998.67	$ 10,616.87	$ 10,935.04	$ 10,305.29	$ 7,526.40	$ 7,458.84	$ 7,239.42
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,686.07	$ 7,954.85	$ 7,548.05	$ 8,285.57	$ 8,318.69	$ 12,137.88	$ 13,829.10	$ 14,205.69	$ 13,590.54	$ 9,709.13	$ 9,570.83	$ 9,327.83
KC Franchise Fee		$ 965.12	$ 883.87	$ 838.67	$ 920.62	$ 924.30	$ 1,348.65	$ 1,536.57	$ 1,578.41	$ 1,510.06	$ 1,078.79	$ 1,063.43	$ 1,036.43
Total Cost		**$ 9,651.19**	**$ 8,838.72**	**$ 8,386.72**	**$ 9,206.19**	**$ 9,242.99**	**$ 13,486.54**	**$ 15,365.67**	**$ 15,784.10**	**$ 15,100.60**	**$ 10,787.92**	**$ 10,634.25**	**$ 10,364.25**
Total Savings	**$ (101.30)**	**$ (7.94)**	**$ (7.94)**	**$ (7.94)**	**$ (7.94)**	**$ (7.94)**	**$ (9.45)**	**$ (9.45)**	**$ (9.45)**	**$ (9.45)**	**$ (7.94)**	**$ (7.94)**	**$ (7.94)**

Current Cost - West Meter		Jan 2010	Feb 2010	Mar 2010	Apr 2010	May 2010	June 2010	July 2010	Aug 2010	Sept 2010	Oct 2010	Nov 2009	Dec 2009
Facilities Demand	kW	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00
Monthly Demand	kW	303.00	297.00	270.00	318.00	324.00	408.00	423.00	435.00	438.00	393.00	366.00	357.00
Energy Use	kWh	133,200.00	114,300.00	109,800.00	118,200.00	117,600.00	140,700.00	176,100.00	181,500.00	166,200.00	138,900.00	141,900.00	137,400.00
Hours Use	hours	439.60	384.85	406.67	371.70	362.96	344.85	416.31	417.24	379.45	353.44	387.70	384.87
FAC Charge		$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84
Demand Charge		$ 793.86	$ 778.14	$ 707.40	$ 833.16	$ 848.88	$ 1,986.14	$ 2,059.16	$ 2,117.58	$ 2,132.18	$ 1,029.66	$ 958.92	$ 935.34
Energy Charge		$ 6,732.00	$ 6,016.50	$ 5,680.44	$ 6,292.20	$ 6,309.60	$ 8,990.17	$ 10,608.37	$ 10,926.54	$ 10,296.79	$ 7,519.26	$ 7,451.70	$ 7,232.28
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,678.92	$ 7,947.70	$ 7,540.90	$ 8,278.42	$ 8,311.54	$ 12,129.38	$ 13,820.60	$ 14,197.18	$ 13,582.04	$ 9,701.98	$ 9,563.68	$ 9,320.68
KC Franchise Fee		$ 964.32	$ 883.08	$ 837.88	$ 919.82	$ 923.50	$ 1,347.71	$ 1,535.62	$ 1,577.46	$ 1,509.12	$ 1,078.00	$ 1,062.63	$ 1,035.63
Total Cost		**$ 9,643.25**	**$ 8,830.78**	**$ 8,378.78**	**$ 9,198.25**	**$ 9,235.05**	**$ 13,477.09**	**$ 15,356.22**	**$ 15,774.65**	**$ 15,091.16**	**$ 10,779.98**	**$ 10,626.32**	**$ 10,356.32**
YEAR 1													
West Meter (-17.566 kW & -1476.1 kWh)		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00
Monthly Demand	kW	285.43	279.43	252.43	300.43	306.43	390.43	405.43	417.43	420.43	375.43	348.43	339.43
Energy Use	kWh	127,285.10	108,395.60	103,876.10	112,283.10	111,685.10	134,781.60	170,178.10	175,583.10	160,281.60	132,985.10	135,990.10	131,474.60
Hours Use	hours	445.94	387.91	411.50	373.74	364.47	345.21	419.74	420.62	381.23	354.22	390.29	387.33
FAC Charge		$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84
Demand Charge		$ 747.84	$ 732.12	$ 661.38	$ 787.14	$ 802.86	$ 1,900.63	$ 1,973.65	$ 2,032.07	$ 2,046.67	$ 983.64	$ 912.90	$ 889.32
Energy Charge		$ 6,406.42	$ 5,691.29	$ 5,354.54	$ 5,966.55	$ 5,984.02	$ 8,609.04	$ 10,227.09	$ 10,545.48	$ 9,915.66	$ 7,193.68	$ 7,126.30	$ 6,906.32
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,307.32	$ 7,576.48	$ 7,168.98	$ 7,906.75	$ 7,939.94	$ 11,662.74	$ 13,353.81	$ 13,730.61	$ 13,115.40	$ 9,330.38	$ 9,192.26	$ 8,948.70
KC Franchise Fee		$ 923.04	$ 841.83	$ 796.55	$ 878.53	$ 882.22	$ 1,295.86	$ 1,483.76	$ 1,525.62	$ 1,457.27	$ 1,036.71	$ 1,021.36	$ 994.30
Total Cost		**$ 9,230.36**	**$ 8,418.31**	**$ 7,965.53**	**$ 8,785.28**	**$ 8,822.16**	**$ 12,958.60**	**$ 14,837.57**	**$ 15,256.23**	**$ 14,572.67**	**$ 10,367.09**	**$ 10,213.62**	**$ 9,943.00**
Total Savings	**$ 5,377.43**	**$ 412.89**	**$ 412.48**	**$ 413.25**	**$ 412.97**	**$ 412.89**	**$ 518.49**	**$ 518.65**	**$ 518.42**	**$ 518.49**	**$ 412.89**	**$ 412.69**	**$ 413.31**
YEAR 2+													
West Meter (-17.566 kW & -1476.1 kWh)		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	420.00	420.00	420.00	420.00	420.00	420.00	420.00	420.00	420.00	420.00	420.00	420.00
Monthly Demand	kW	285.43	279.43	252.43	300.43	306.43	390.43	405.43	417.43	420.43	375.43	348.43	339.43
Energy Use	kWh	127,285.10	108,395.60	103,876.10	112,283.10	111,685.10	134,781.60	170,178.10	175,583.10	160,281.60	132,985.10	135,990.10	131,474.60
Hours Use	hours	445.94	387.91	411.50	373.74	364.47	345.21	419.74	420.62	381.23	354.22	390.29	387.33
FAC Charge		$ 1,023.96	$ 1,023.96	$ 1,023.96	$ 1,023.96	$ 1,023.96	$ 1,023.96	$ 1,023.96	$ 1,023.96	$ 1,023.96	$ 1,023.96	$ 1,023.96	$ 1,023.96
Demand Charge		$ 747.84	$ 732.12	$ 661.38	$ 787.14	$ 802.86	$ 1,900.63	$ 1,973.65	$ 2,032.07	$ 2,046.67	$ 983.64	$ 912.90	$ 889.32
Energy Charge		$ 6,406.42	$ 5,691.29	$ 5,354.54	$ 5,966.55	$ 5,984.02	$ 8,609.04	$ 10,227.09	$ 10,545.48	$ 9,915.66	$ 7,193.68	$ 7,126.30	$ 6,906.32
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,263.44	$ 7,532.59	$ 7,125.09	$ 7,862.86	$ 7,896.06	$ 11,618.86	$ 13,309.93	$ 13,686.72	$ 13,071.52	$ 9,286.50	$ 9,148.37	$ 8,904.82
KC Franchise Fee		$ 918.16	$ 836.95	$ 791.68	$ 873.65	$ 877.34	$ 1,290.98	$ 1,478.88	$ 1,520.75	$ 1,452.39	$ 1,031.83	$ 1,016.49	$ 989.42
Total Cost		**$ 9,181.60**	**$ 8,369.55**	**$ 7,916.77**	**$ 8,736.52**	**$ 8,773.40**	**$ 12,909.84**	**$ 14,788.81**	**$ 15,207.47**	**$ 14,523.91**	**$ 10,318.33**	**$ 10,164.86**	**$ 9,894.24**
Total Savings	**$ 5,962.55**	**$ 461.65**	**$ 461.24**	**$ 462.01**	**$ 461.73**	**$ 461.65**	**$ 567.25**	**$ 567.41**	**$ 567.18**	**$ 567.25**	**$ 461.65**	**$ 461.45**	**$ 462.07**

Figure D.5. Refrigeration lighting west meter cost savings calculation

Figure D.6. Refrigeration infiltration full length vinyl strips west meter cost savings calculation

Current Cost - West Meter		Jan 2010	Feb 2010	Mar 2010	Apr 2010	May 2010	June 2010	July 2010	Aug 2010	Sept 2010	Oct 2010	Nov 2009	Dec 2009
Facilities Demand	kW	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00
Monthly Demand	kW	303.00	297.00	270.00	318.00	324.00	408.00	423.00	435.00	438.00	393.00	366.00	357.00
Energy Use	kWh	133,200.00	114,300.00	109,800.00	118,200.00	117,600.00	140,700.00	176,100.00	181,500.00	166,200.00	138,900.00	141,900.00	137,400.00
Hours Use	hours	439.60	384.85	406.67	371.70	362.96	344.85	416.31	417.24	379.45	353.44	387.70	384.87
FAC Charge		$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84
Demand Charge		$ 793.86	$ 778.14	$ 707.40	$ 833.16	$ 848.88	$ 1,986.14	$ 2,059.16	$ 2,117.58	$ 2,132.18	$ 1,029.66	$ 958.92	$ 935.34
Energy Charge		$ 6,732.00	$ 6,016.50	$ 5,680.44	$ 6,292.20	$ 6,309.60	$ 8,990.17	$ 10,608.37	$ 10,926.54	$ 10,296.79	$ 7,519.26	$ 7,451.70	$ 7,232.28
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,678.92	$ 7,947.70	$ 7,540.90	$ 8,278.42	$ 8,311.54	$ 12,129.38	$ 13,820.60	$ 14,197.18	$ 13,582.04	$ 9,701.98	$ 9,563.68	$ 9,320.68
KC Franchise Fee		$ 964.32	$ 883.08	$ 837.88	$ 919.82	$ 923.50	$ 1,347.71	$ 1,535.62	$ 1,577.46	$ 1,509.12	$ 1,078.00	$ 1,062.63	$ 1,035.63
Total Cost		**$ 9,643.25**	**$ 8,830.78**	**$ 8,378.78**	**$ 9,198.25**	**$ 9,235.05**	**$ 13,477.09**	**$ 15,356.22**	**$ 15,774.65**	**$ 15,091.16**	**$ 10,779.98**	**$ 10,626.32**	**$ 10,356.32**
YEAR 1													
West Meter		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00
Monthly Demand	kW	293.38	287.38	259.75	306.75	309.14	391.67	407.10	422.46	428.16	383.60	356.49	347.38
Energy Use	kWh	129,199.40	110,607.10	105,373.40	113,520.80	111,418.70	133,904.50	169,231.20	176,283.30	162,107.40	134,987.80	137,943.60	133,245.50
Hours Use	hours	440.38	384.88	405.67	370.07	360.41	341.89	415.70	417.28	378.61	351.90	386.95	383.57
FAC Charge		$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84
Demand Charge		$ 768.66	$ 752.94	$ 680.55	$ 803.69	$ 809.95	$ 1,906.63	$ 1,981.76	$ 2,056.54	$ 2,084.29	$ 1,005.02	$ 934.00	$ 910.14
Energy Charge		$ 6,526.46	$ 5,821.98	$ 5,455.57	$ 6,051.80	$ 5,992.02	$ 8,580.72	$ 10,198.99	$ 10,612.21	$ 10,050.20	$ 7,318.27	$ 7,248.43	$ 7,021.23
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,448.19	$ 7,727.98	$ 7,289.18	$ 8,008.55	$ 7,955.04	$ 11,640.41	$ 13,333.82	$ 13,821.81	$ 13,287.55	$ 9,476.35	$ 9,335.49	$ 9,084.44
KC Franchise Fee		$ 938.69	$ 858.66	$ 809.91	$ 889.84	$ 883.89	$ 1,293.38	$ 1,481.54	$ 1,535.76	$ 1,476.39	$ 1,052.93	$ 1,037.28	$ 1,009.38
Total Cost		**$ 9,386.88**	**$ 8,586.65**	**$ 8,099.09**	**$ 8,898.39**	**$ 8,838.93**	**$ 12,933.79**	**$ 14,815.35**	**$ 15,357.57**	**$ 14,763.95**	**$ 10,529.28**	**$ 10,372.77**	**$ 10,093.82**
Total Savings	**$ 4,071.37**	**$ 256.37**	**$ 244.13**	**$ 279.69**	**$ 299.86**	**$ 396.12**	**$ 543.30**	**$ 540.87**	**$ 417.08**	**$ 327.21**	**$ 250.70**	**$ 253.54**	**$ 262.50**
YEAR 2+													
West Meter		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	428.00	428.00	428.00	428.00	428.00	428.00	428.00	428.00	428.00	428.00	428.00	428.00
Monthly Demand	kW	293.38	287.38	259.75	306.75	309.14	391.67	407.10	422.46	428.16	383.60	356.49	347.38
Energy Use	kWh	129,199.40	110,607.10	105,373.40	113,520.80	111,418.70	133,904.50	169,231.20	176,283.30	162,107.40	134,987.80	137,943.60	133,245.50
Hours Use	hours	440.38	384.88	405.67	370.07	360.41	341.89	415.70	417.28	378.61	351.90	386.95	383.57
FAC Charge		$ 1,043.46	$ 1,043.46	$ 1,043.46	$ 1,043.46	$ 1,043.46	$ 1,043.46	$ 1,043.46	$ 1,043.46	$ 1,043.46	$ 1,043.46	$ 1,043.46	$ 1,043.46
Demand Charge		$ 768.66	$ 752.94	$ 680.55	$ 803.69	$ 809.95	$ 1,906.63	$ 1,981.76	$ 2,056.54	$ 2,084.29	$ 1,005.02	$ 934.00	$ 910.14
Energy Charge		$ 6,526.46	$ 5,821.98	$ 5,455.57	$ 6,051.80	$ 5,992.02	$ 8,580.72	$ 10,198.99	$ 10,612.21	$ 10,050.20	$ 7,318.27	$ 7,248.43	$ 7,021.23
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,423.81	$ 7,703.60	$ 7,264.80	$ 7,984.17	$ 7,930.66	$ 11,616.03	$ 13,309.44	$ 13,797.43	$ 13,263.17	$ 9,451.97	$ 9,311.11	$ 9,060.06
KC Franchise Fee		$ 935.98	$ 855.96	$ 807.20	$ 887.13	$ 881.18	$ 1,290.67	$ 1,478.83	$ 1,533.05	$ 1,473.69	$ 1,050.22	$ 1,034.57	$ 1,006.67
Total Cost		**$ 9,359.79**	**$ 8,559.56**	**$ 8,072.00**	**$ 8,871.30**	**$ 8,811.84**	**$ 12,906.70**	**$ 14,788.26**	**$ 15,330.48**	**$ 14,736.86**	**$ 10,502.19**	**$ 10,345.68**	**$ 10,066.73**
Total Savings	**$ 4,396.44**	**$ 283.46**	**$ 271.22**	**$ 306.78**	**$ 326.95**	**$ 423.21**	**$ 570.39**	**$ 567.96**	**$ 444.17**	**$ 354.30**	**$ 277.79**	**$ 280.63**	**$ 289.58**

Current Cost - West Meter		Jan 2010	Feb 2010	Mar 2010	Apr 2010	May 2010	June 2010	July 2010	Aug 2010	Sept 2010	Oct 2010	Nov 2009	Dec 2009
Facilities Demand	kW	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00
Monthly Demand	kW	303.00	297.00	270.00	318.00	324.00	408.00	423.00	435.00	438.00	393.00	366.00	357.00
Energy Use	kWh	133,200.00	114,300.00	109,800.00	118,200.00	117,600.00	140,700.00	176,100.00	181,500.00	166,200.00	138,900.00	141,900.00	137,400.00
Hours Use	hours	439.60	384.85	406.67	371.70	362.96	344.85	416.31	417.24	379.45	353.44	387.70	384.87
FAC Charge		$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84
Demand Charge		$ 793.86	$ 778.14	$ 707.40	$ 833.16	$ 848.88	$ 1,986.14	$ 2,059.16	$ 2,117.58	$ 2,132.18	$ 1,029.66	$ 958.92	$ 935.34
Energy Charge		$ 6,732.00	$ 6,016.50	$ 5,680.44	$ 6,292.20	$ 6,309.60	$ 8,990.17	$ 10,608.37	$ 10,926.54	$ 10,296.79	$ 7,519.26	$ 7,451.70	$ 7,232.28
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,678.92	$ 7,947.70	$ 7,540.90	$ 8,278.42	$ 8,311.54	$ 12,129.38	$ 13,820.60	$ 14,197.18	$ 13,582.04	$ 9,701.98	$ 9,563.68	$ 9,320.68
KC Franchise Fee		$ 964.32	$ 883.08	$ 837.88	$ 919.82	$ 923.50	$ 1,347.71	$ 1,535.62	$ 1,577.46	$ 1,509.12	$ 1,078.00	$ 1,062.63	$ 1,035.63
Total Cost		**$ 9,643.25**	**$ 8,830.78**	**$ 8,378.78**	**$ 9,198.25**	**$ 9,235.05**	**$ 13,477.09**	**$ 15,356.22**	**$ 15,774.65**	**$ 15,091.16**	**$ 10,779.98**	**$ 10,626.32**	**$ 10,356.32**
YEAR 1													
West Meter		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00
Monthly Demand	kW	297.34	291.34	263.97	311.38	315.26	398.39	413.65	427.62	432.21	387.47	360.41	351.34
Energy Use	kWh	130,846.70	112,127.70	107,196.10	115,447.50	113,964.00	136,702.70	172,059.50	178,431.40	163,792.60	136,598.70	139,572.70	134,956.20
Hours Use	hours	440.05	384.86	406.09	370.76	361.49	343.14	415.96	417.26	378.96	352.54	387.27	384.12
FAC Charge		$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84
Demand Charge		$ 779.04	$ 763.32	$ 691.61	$ 815.82	$ 825.98	$ 1,939.37	$ 2,013.63	$ 2,081.67	$ 2,104.01	$ 1,015.17	$ 944.26	$ 920.52
Energy Charge		$ 6,611.09	$ 5,902.07	$ 5,548.16	$ 6,150.78	$ 6,122.79	$ 8,749.32	$ 10,367.56	$ 10,741.64	$ 10,151.74	$ 7,401.03	$ 7,332.13	$ 7,108.13
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,543.20	$ 7,818.46	$ 7,392.83	$ 8,119.67	$ 8,101.83	$ 11,841.75	$ 13,534.26	$ 13,976.37	$ 13,408.81	$ 9,569.26	$ 9,429.45	$ 9,181.72
KC Franchise Fee		$ 949.24	$ 868.72	$ 821.43	$ 902.19	$ 900.20	$ 1,315.75	$ 1,503.81	$ 1,552.93	$ 1,489.87	$ 1,063.25	$ 1,047.72	$ 1,020.19
Total Cost		**$ 9,492.44**	**$ 8,687.17**	**$ 8,214.26**	**$ 9,021.86**	**$ 9,002.04**	**$ 13,157.50**	**$ 15,038.06**	**$ 15,529.30**	**$ 14,898.68**	**$ 10,632.51**	**$ 10,477.17**	**$ 10,201.91**
Total Savings	**$ 2,394.95**	**$ 150.81**	**$ 143.61**	**$ 164.53**	**$ 176.39**	**$ 233.01**	**$ 319.59**	**$ 318.16**	**$ 245.34**	**$ 192.47**	**$ 147.48**	**$ 149.15**	**$ 154.41**
YEAR 2+													
West Meter		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	432.00	432.00	432.00	432.00	432.00	432.00	432.00	432.00	432.00	432.00	432.00	432.00
Monthly Demand	kW	297.34	291.34	263.97	311.38	315.26	398.39	413.65	427.62	432.21	387.47	360.41	351.34
Energy Use	kWh	130,846.70	112,127.70	107,196.10	115,447.50	113,964.00	136,702.70	172,059.50	178,431.40	163,792.60	136,598.70	139,572.70	134,956.20
Hours Use	hours	440.05	384.86	406.09	370.76	361.49	343.14	415.96	417.26	378.96	352.54	387.27	384.12
FAC Charge		$ 1,053.22	$ 1,053.22	$ 1,053.22	$ 1,053.22	$ 1,053.22	$ 1,053.22	$ 1,053.22	$ 1,053.22	$ 1,053.22	$ 1,053.22	$ 1,053.22	$ 1,053.22
Demand Charge		$ 779.04	$ 763.32	$ 691.61	$ 815.82	$ 825.98	$ 1,939.37	$ 2,013.63	$ 2,081.67	$ 2,104.01	$ 1,015.17	$ 944.26	$ 920.52
Energy Charge		$ 6,611.09	$ 5,902.07	$ 5,548.16	$ 6,150.78	$ 6,122.79	$ 8,749.32	$ 10,367.56	$ 10,741.64	$ 10,151.74	$ 7,401.03	$ 7,332.13	$ 7,108.13
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,528.57	$ 7,803.83	$ 7,378.20	$ 8,105.04	$ 8,087.20	$ 11,827.12	$ 13,519.63	$ 13,961.75	$ 13,394.19	$ 9,554.63	$ 9,414.82	$ 9,167.09
KC Franchise Fee		$ 947.62	$ 867.09	$ 819.80	$ 900.56	$ 898.58	$ 1,314.12	$ 1,502.18	$ 1,551.31	$ 1,488.24	$ 1,061.63	$ 1,046.09	$ 1,018.57
Total Cost		**$ 9,476.19**	**$ 8,670.92**	**$ 8,198.00**	**$ 9,005.60**	**$ 8,985.78**	**$ 13,141.25**	**$ 15,021.81**	**$ 15,513.05**	**$ 14,882.43**	**$ 10,616.25**	**$ 10,460.92**	**$ 10,185.65**
Total Savings	**$ 2,589.99**	**$ 167.06**	**$ 159.86**	**$ 180.78**	**$ 192.65**	**$ 249.27**	**$ 335.84**	**$ 334.41**	**$ 261.60**	**$ 208.73**	**$ 163.73**	**$ 165.40**	**$ 170.66**

Figure D.7. Refrigeration infiltration 50% duration west meter cost savings calculation

Current Cost - West Meter		Jan 2010	Feb 2010	Mar 2010	Apr 2010	May 2010	June 2010	July 2010	Aug 2010	Sept 2010	Oct 2010	Nov 2009	Dec 2009
Facilities Demand	kW	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00
Monthly Demand	kW	303.00	297.00	270.00	318.00	324.00	408.00	423.00	435.00	438.00	393.00	366.00	357.00
Energy Use	kWh	133,200.00	114,300.00	109,800.00	118,200.00	117,600.00	140,700.00	176,100.00	181,500.00	166,200.00	138,900.00	141,900.00	137,400.00
Hours Use	hours	439.60	384.85	406.67	371.70	362.96	344.85	416.31	417.24	379.45	353.44	387.70	384.87
FAC Charge		$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84
Demand Charge		$ 793.86	$ 778.14	$ 707.40	$ 833.16	$ 848.88	$ 1,986.14	$ 2,059.16	$ 2,117.58	$ 2,132.18	$ 1,029.66	$ 958.92	$ 935.34
Energy Charge		$ 6,732.00	$ 6,016.50	$ 5,680.44	$ 6,292.20	$ 6,309.60	$ 8,990.17	$ 10,608.37	$ 10,926.54	$ 10,296.79	$ 7,519.26	$ 7,451.70	$ 7,232.28
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,678.92	$ 7,947.70	$ 7,540.90	$ 8,278.42	$ 8,311.54	$ 12,129.38	$ 13,820.60	$ 14,197.18	$ 13,582.04	$ 9,701.98	$ 9,563.68	$ 9,320.68
KC Franchise Fee		$ 964.32	$ 883.08	$ 837.88	$ 919.82	$ 923.50	$ 1,347.71	$ 1,535.62	$ 1,577.46	$ 1,509.12	$ 1,078.00	$ 1,062.63	$ 1,035.63
Total Cost		**$ 9,643.25**	**$ 8,830.78**	**$ 8,378.78**	**$ 9,198.25**	**$ 9,235.05**	**$ 13,477.09**	**$ 15,356.22**	**$ 15,774.65**	**$ 15,091.16**	**$ 10,779.98**	**$ 10,626.32**	**$ 10,356.32**
YEAR 1													
West Meter		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00
Monthly Demand	kW	300.60	294.60	266.59	312.97	313.16	394.78	410.48	427.89	435.25	390.94	363.77	354.60
Energy Use	kWh	132,202.22	113,378.98	108,325.28	116,108.98	113,089.23	135,199.32	170,691.01	178,543.36	165,053.96	138,044.50	140,973.36	136,363.85
Hours Use	hours	439.79	384.86	406.34	370.99	361.13	342.47	415.83	417.26	379.22	353.11	387.53	384.56
FAC Charge		$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84
Demand Charge		$ 787.58	$ 771.86	$ 698.46	$ 819.99	$ 820.47	$ 1,921.78	$ 1,998.21	$ 2,082.98	$ 2,118.77	$ 1,024.27	$ 953.08	$ 929.06
Energy Charge		$ 6,680.74	$ 5,967.99	$ 5,605.52	$ 6,184.77	$ 6,077.85	$ 8,658.73	$ 10,286.00	$ 10,748.39	$ 10,227.74	$ 7,475.31	$ 7,404.09	$ 7,179.64
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,621.38	$ 7,892.90	$ 7,457.04	$ 8,157.82	$ 8,051.39	$ 11,733.57	$ 13,437.27	$ 13,984.44	$ 13,499.58	$ 9,652.64	$ 9,510.24	$ 9,261.76
KC Franchise Fee		$ 957.93	$ 876.99	$ 828.56	$ 906.42	$ 894.60	$ 1,303.73	$ 1,493.03	$ 1,553.83	$ 1,499.95	$ 1,072.52	$ 1,056.69	$ 1,029.08
Total Cost		**$ 9,579.31**	**$ 8,769.89**	**$ 8,285.60**	**$ 9,064.25**	**$ 8,945.98**	**$ 13,037.30**	**$ 14,930.30**	**$ 15,538.26**	**$ 14,999.53**	**$ 10,725.16**	**$ 10,566.93**	**$ 10,290.85**
Total Savings	**$ 2,014.46**	**$ 63.94**	**$ 60.89**	**$ 93.18**	**$ 134.00**	**$ 289.07**	**$ 439.78**	**$ 425.92**	**$ 236.39**	**$ 91.63**	**$ 54.82**	**$ 59.38**	**$ 65.47**
YEAR 2+													
West Meter		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	435.00	435.00	435.00	435.00	435.00	435.00	435.00	435.00	435.00	435.00	435.00	435.00
Monthly Demand	kW	300.60	294.60	266.59	312.97	313.16	394.78	410.48	427.89	435.25	390.94	363.77	354.60
Energy Use	kWh	132,202.22	113,378.98	108,325.28	116,108.98	113,089.23	135,199.32	170,691.01	178,543.36	165,053.96	138,044.50	140,973.36	136,363.85
Hours Use	hours	439.79	384.86	406.34	370.99	361.13	342.47	415.83	417.26	379.22	353.11	387.53	384.56
FAC Charge		$ 1,060.53	$ 1,060.53	$ 1,060.53	$ 1,060.53	$ 1,060.53	$ 1,060.53	$ 1,060.53	$ 1,060.53	$ 1,060.53	$ 1,060.53	$ 1,060.53	$ 1,060.53
Demand Charge		$ 787.58	$ 771.86	$ 698.46	$ 819.99	$ 820.47	$ 1,921.78	$ 1,998.21	$ 2,082.98	$ 2,118.77	$ 1,024.27	$ 953.08	$ 929.06
Energy Charge		$ 6,680.74	$ 5,967.99	$ 5,605.52	$ 6,184.77	$ 6,077.85	$ 8,658.73	$ 10,286.00	$ 10,748.39	$ 10,227.74	$ 7,475.31	$ 7,404.09	$ 7,179.64
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,614.06	$ 7,885.59	$ 7,449.73	$ 8,150.51	$ 8,044.07	$ 11,726.26	$ 13,429.96	$ 13,977.12	$ 13,492.26	$ 9,645.33	$ 9,502.93	$ 9,254.45
KC Franchise Fee		$ 957.12	$ 876.18	$ 827.75	$ 905.61	$ 893.79	$ 1,302.92	$ 1,492.22	$ 1,553.01	$ 1,499.14	$ 1,071.70	$ 1,055.88	$ 1,028.27
Total Cost		**$ 9,571.18**	**$ 8,761.77**	**$ 8,277.48**	**$ 9,056.12**	**$ 8,937.86**	**$ 13,029.18**	**$ 14,922.18**	**$ 15,530.14**	**$ 14,991.40**	**$ 10,717.03**	**$ 10,558.81**	**$ 10,282.72**
Total Savings	**$ 2,111.98**	**$ 72.07**	**$ 69.01**	**$ 101.30**	**$ 142.13**	**$ 297.19**	**$ 447.91**	**$ 434.05**	**$ 244.51**	**$ 99.75**	**$ 62.95**	**$ 67.51**	**$ 73.59**

Figure D.8. Refrigeration infiltration dock seals west meter cost savings calculation

Current Cost - East Meter		Jan 2010	Feb 2010	Mar 2010	Apr 2010	May 2010	June 2010	July 2010	Aug 2010	Sept 2010	Oct 2010	Nov 2009	Dec 2009
Facilities Demand	kW	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00
Monthly Demand	kW	189.60	151.20	132.00	141.60	151.20	189.60	201.60	206.40	206.40	177.60	184.80	189.60
Energy Use	kWh	84,480.00	61,920.00	57,120.00	55,920.00	56,880.00	67,440.00	78,720.00	85,200.00	80,400.00	64,080.00	84,480.00	84,960.00
Hours Use	hours	445.57	409.52	432.73	394.92	376.19	355.70	390.48	412.79	389.53	360.81	457.14	448.10
FAC Charge		$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23
Demand Charge		$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 973.60	$ 981.39	$ 1,004.76	$ 1,004.76	$ 524.00	$ 524.00	$ 524.00
Energy Charge		$ 4,252.99	$ 3,196.51	$ 2,900.26	$ 2,919.50	$ 3,016.08	$ 4,265.37	$ 4,834.02	$ 5,145.32	$ 4,940.84	$ 3,444.91	$ 4,221.89	$ 4,270.18
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 5,364.44	$ 4,307.96	$ 4,011.70	$ 4,030.95	$ 4,127.53	$ 5,826.41	$ 6,402.86	$ 6,737.52	$ 6,533.04	$ 4,556.36	$ 5,333.34	$ 5,381.62
KC Franchise Fee		$ 596.05	$ 478.66	$ 445.74	$ 447.88	$ 458.61	$ 647.38	$ 711.43	$ 748.61	$ 725.89	$ 506.26	$ 592.59	$ 597.96
Total Cost		**$ 5,960.49**	**$ 4,786.62**	**$ 4,457.45**	**$ 4,478.84**	**$ 4,586.14**	**$ 6,473.79**	**$ 7,114.29**	**$ 7,486.14**	**$ 7,258.94**	**$ 5,062.62**	**$ 5,925.93**	**$ 5,979.58**
YEAR 1													
100% Shift (East Meter) (-36.907kW)		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00
Monthly Demand	kW	156.38	117.98	98.78	108.38	117.98	156.38	168.38	173.18	173.18	144.38	151.58	156.38
Energy Use	kWh	84,480.00	61,920.00	57,120.00	55,920.00	56,880.00	67,440.00	78,720.00	85,200.00	80,400.00	64,080.00	84,480.00	84,960.00
Hours Use	hours	540.21	524.82	578.23	515.94	482.10	431.25	467.50	491.96	464.25	443.82	557.31	543.28
FAC Charge		$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23
Demand Charge		$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 973.60	$ 973.60	$ 973.60	$ 973.60	$ 524.00	$ 524.00	$ 524.00
Energy Charge		$ 4,037.75	$ 2,981.27	$ 2,685.02	$ 2,704.26	$ 2,800.84	$ 4,021.43	$ 4,590.08	$ 4,901.38	$ 4,696.90	$ 3,229.67	$ 4,006.65	$ 4,054.94
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 5,149.20	$ 4,092.72	$ 3,796.46	$ 3,815.71	$ 3,912.29	$ 5,582.48	$ 6,151.13	$ 6,462.43	$ 6,257.95	$ 4,341.12	$ 5,118.10	$ 5,166.38
KC Franchise Fee		$ 572.13	$ 454.75	$ 421.83	$ 423.97	$ 434.70	$ 620.28	$ 683.46	$ 718.05	$ 695.33	$ 482.35	$ 568.68	$ 574.04
Total Cost		**$ 5,721.33**	**$ 4,547.47**	**$ 4,218.29**	**$ 4,239.68**	**$ 4,346.99**	**$ 6,202.75**	**$ 6,834.59**	**$ 7,180.48**	**$ 6,953.28**	**$ 4,823.47**	**$ 5,686.77**	**$ 5,740.43**
Total Savings	**$ 3,075.30**	**$ 239.16**	**$ 239.16**	**$ 239.16**	**$ 239.16**	**$ 239.16**	**$ 271.04**	**$ 279.70**	**$ 305.66**	**$ 305.66**	**$ 239.16**	**$ 239.16**	**$ 239.16**
YEAR 2+													
100% Shift (East Meter) (-36.907kW)		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	173	173	173	173	173	173	173	173	173	173	173	173
Monthly Demand	kW	156.38	117.98	98.78	108.38	117.98	156.38	168.38	173.18	173.18	144.38	151.58	156.38
Energy Use	kWh	84,480.00	61,920.00	57,120.00	55,920.00	56,880.00	67,440.00	78,720.00	85,200.00	80,400.00	64,080.00	84,480.00	84,960.00
Hours Use	hours	540.21	524.82	578.23	515.94	482.10	431.25	467.50	491.96	464.25	443.82	557.31	543.28
FAC Charge		$ 421.77	$ 421.77	$ 421.77	$ 421.77	$ 421.77	$ 421.77	$ 421.77	$ 421.77	$ 421.77	$ 421.77	$ 421.77	$ 421.77
Demand Charge		$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 973.60	$ 973.60	$ 973.60	$ 973.60	$ 524.00	$ 524.00	$ 524.00
Energy Charge		$ 4,037.75	$ 2,981.27	$ 2,685.02	$ 2,704.26	$ 2,800.84	$ 4,021.43	$ 4,590.08	$ 4,901.38	$ 4,696.90	$ 3,229.67	$ 4,006.65	$ 4,054.94
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 5,068.75	$ 4,012.27	$ 3,716.01	$ 3,735.26	$ 3,831.83	$ 5,502.02	$ 6,070.68	$ 6,381.98	$ 6,177.50	$ 4,260.67	$ 5,037.64	$ 5,085.93
KC Franchise Fee		$ 563.19	$ 445.81	$ 412.89	$ 415.03	$ 425.76	$ 611.34	$ 674.52	$ 709.11	$ 686.39	$ 473.41	$ 559.74	$ 565.10
Total Cost		**$ 5,631.94**	**$ 4,458.07**	**$ 4,128.90**	**$ 4,150.29**	**$ 4,257.59**	**$ 6,113.36**	**$ 6,745.20**	**$ 7,091.09**	**$ 6,863.89**	**$ 4,734.07**	**$ 5,597.38**	**$ 5,651.03**
Total Savings	**$ 4,148.02**	**$ 328.55**	**$ 328.55**	**$ 328.55**	**$ 328.55**	**$ 328.55**	**$ 360.44**	**$ 369.09**	**$ 395.05**	**$ 395.05**	**$ 328.55**	**$ 328.55**	**$ 328.55**

Figure D.9. Forklift charging stations east meter cost savings calculation

Current Cost - West Meter		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00
Monthly Demand	kW	303.00	297.00	270.00	318.00	324.00	408.00	423.00	435.00	438.00	393.00	366.00	357.00
Energy Use	kWh	133,200.00	114,300.00	109,800.00	118,200.00	117,600.00	140,700.00	176,100.00	181,500.00	166,200.00	138,900.00	141,900.00	137,400.00
Hours Use	hours	439.60	384.85	406.67	371.70	362.96	344.85	416.31	417.24	379.45	353.44	387.70	384.87
FAC Charge		$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84
Demand Charge		$ 793.86	$ 778.14	$ 707.40	$ 833.16	$ 848.88	$ 1,986.14	$ 2,059.16	$ 2,117.58	$ 2,132.18	$ 1,029.66	$ 958.92	$ 935.34
Energy Charge		$ 6,732.00	$ 6,016.50	$ 5,680.44	$ 6,292.20	$ 6,309.60	$ 8,990.17	$ 10,608.37	$ 10,926.54	$ 10,296.79	$ 7,519.26	$ 7,451.70	$ 7,232.28
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,678.92	$ 7,947.70	$ 7,540.90	$ 8,278.42	$ 8,311.54	$ 12,129.38	$ 13,820.60	$ 14,197.18	$ 13,582.04	$ 9,701.98	$ 9,563.68	$ 9,320.68
KC Franchise Fee		$ 964.32	$ 883.08	$ 837.88	$ 919.82	$ 923.50	$ 1,347.71	$ 1,535.62	$ 1,577.46	$ 1,509.12	$ 1,078.00	$ 1,062.63	$ 1,035.63
Total Cost		**$ 9,643.25**	**$ 8,830.78**	**$ 8,378.78**	**$ 9,198.25**	**$ 9,235.05**	**$ 13,477.09**	**$ 15,356.22**	**$ 15,774.65**	**$ 15,091.16**	**$ 10,779.98**	**$ 10,626.32**	**$ 10,356.32**
YEAR 1													
(West Meter) (-67.465kW)		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00
Monthly Demand	kW	235.54	229.54	202.54	250.54	256.54	340.54	355.54	367.54	370.54	325.54	298.54	289.54
Energy Use	kWh	133,200.00	114,300.00	109,800.00	118,200.00	117,600.00	140,700.00	176,100.00	181,500.00	166,200.00	138,900.00	141,900.00	137,400.00
Hours Use	hours	565.52	497.96	542.13	471.79	458.42	413.17	495.31	493.83	448.54	426.68	475.32	474.55
FAC Charge		$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84
Demand Charge		$ 617.10	$ 601.38	$ 524.00	$ 656.40	$ 672.12	$ 1,657.72	$ 1,730.74	$ 1,789.16	$ 1,803.76	$ 852.90	$ 782.16	$ 758.58
Energy Charge		$ 6,294.83	$ 5,579.33	$ 5,243.27	$ 5,855.03	$ 5,872.43	$ 8,494.71	$ 10,112.91	$ 10,431.08	$ 9,801.33	$ 7,082.09	$ 7,014.53	$ 6,795.11
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,064.99	$ 7,333.77	$ 6,920.33	$ 7,664.49	$ 7,697.61	$ 11,305.50	$ 12,996.72	$ 13,373.30	$ 12,758.16	$ 9,088.05	$ 8,949.75	$ 8,706.75
KC Franchise Fee		$ 896.11	$ 814.86	$ 768.93	$ 851.61	$ 855.29	$ 1,256.17	$ 1,444.08	$ 1,485.92	$ 1,417.57	$ 1,009.78	$ 994.42	$ 967.42
Total Cost		**$ 8,961.10**	**$ 8,148.64**	**$ 7,689.26**	**$ 8,516.10**	**$ 8,552.90**	**$ 12,561.66**	**$ 14,440.80**	**$ 14,859.22**	**$ 14,175.73**	**$ 10,097.84**	**$ 9,944.17**	**$ 9,674.17**
Total Savings	**$ 9,126.25**	**$ 682.15**	**$ 682.15**	**$ 689.53**	**$ 682.15**	**$ 682.15**	**$ 915.43**	**$ 915.43**	**$ 915.43**	**$ 915.43**	**$ 682.15**	**$ 682.15**	**$ 682.15**
YEAR 2+													
(West Meter) (-67.465kW)		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	371	371	371	371	371	371	371	371	371	371	371	371
Monthly Demand	kW	235.54	229.54	202.54	250.54	256.54	340.54	355.54	367.54	370.54	325.54	298.54	289.54
Energy Use	kWh	133,200.00	114,300.00	109,800.00	118,200.00	117,600.00	140,700.00	176,100.00	181,500.00	166,200.00	138,900.00	141,900.00	137,400.00
Hours Use	hours	565.52	497.96	542.13	471.79	458.42	413.17	495.31	493.83	448.54	426.68	475.32	474.55
FAC Charge		$ 904.50	$ 904.50	$ 904.50	$ 904.50	$ 904.50	$ 904.50	$ 904.50	$ 904.50	$ 904.50	$ 904.50	$ 904.50	$ 904.50
Demand Charge		$ 617.10	$ 601.38	$ 524.00	$ 656.40	$ 672.12	$ 892.20	$ 931.50	$ 962.94	$ 970.80	$ 852.90	$ 782.16	$ 758.58
Energy Charge		$ 6,294.83	$ 5,579.33	$ 5,243.27	$ 5,855.03	$ 5,872.43	$ 8,494.71	$ 10,112.91	$ 10,431.08	$ 9,801.33	$ 7,082.09	$ 7,014.53	$ 6,795.11
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 7,901.65	$ 7,170.43	$ 6,756.98	$ 7,501.15	$ 7,534.27	$ 10,376.63	$ 12,034.13	$ 12,383.74	$ 11,761.85	$ 8,924.71	$ 8,786.41	$ 8,543.41
KC Franchise Fee		$ 877.96	$ 796.71	$ 750.78	$ 833.46	$ 837.14	$ 1,152.96	$ 1,337.13	$ 1,375.97	$ 1,306.87	$ 991.63	$ 976.27	$ 949.27
Total Cost		**$ 8,779.61**	**$ 7,967.14**	**$ 7,507.76**	**$ 8,334.61**	**$ 8,371.41**	**$ 11,529.59**	**$ 13,371.25**	**$ 13,759.71**	**$ 13,068.72**	**$ 9,916.34**	**$ 9,762.67**	**$ 9,492.67**
Total Savings	**$ 14,886.36**	**$ 863.64**	**$ 863.64**	**$ 871.02**	**$ 863.64**	**$ 863.64**	**$ 1,947.50**	**$ 1,984.97**	**$ 2,014.94**	**$ 2,022.43**	**$ 863.64**	**$ 863.64**	**$ 863.64**

Figure D.10. Forklift charging stations west meter cost savings calculation

Current Cost - East Meter		Jan 2010	Feb 2010	Mar 2010	Apr 2010	May 2010	June 2010	July 2010	Aug 2010	Sept 2010	Oct 2010	Nov 2009	Dec 2009
Facilities Demand	kW	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00
Monthly Demand	kW	189.60	151.20	132.00	141.60	151.20	189.60	201.60	206.40	206.40	177.60	184.80	189.60
Energy Use	kWh	84,480.00	61,920.00	57,120.00	55,920.00	56,880.00	67,440.00	78,720.00	85,200.00	80,400.00	64,080.00	84,480.00	84,960.00
Hours Use	hours	445.57	409.52	432.73	394.92	376.19	355.70	390.48	412.79	389.53	360.81	457.14	448.10
FAC Charge		$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23
Demand Charge		$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 973.60	$ 981.39	$ 1,004.76	$ 1,004.76	$ 524.00	$ 524.00	$ 524.00
Energy Charge		$ 4,252.99	$ 3,196.51	$ 2,900.26	$ 2,919.50	$ 3,016.08	$ 4,265.37	$ 4,834.02	$ 5,145.32	$ 4,940.84	$ 3,444.91	$ 4,221.89	$ 4,270.18
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 5,364.44	$ 4,307.96	$ 4,011.70	$ 4,030.95	$ 4,127.53	$ 5,826.41	$ 6,402.86	$ 6,737.52	$ 6,533.04	$ 4,556.36	$ 5,333.34	$ 5,381.62
KC Franchise Fee		$ 596.05	$ 478.66	$ 445.74	$ 447.88	$ 458.61	$ 647.38	$ 711.43	$ 748.61	$ 725.89	$ 506.26	$ 592.59	$ 597.96
Total Cost		**$ 5,960.49**	**$ 4,786.62**	**$ 4,457.45**	**$ 4,478.84**	**$ 4,586.14**	**$ 6,473.79**	**$ 7,114.29**	**$ 7,486.14**	**$ 7,258.94**	**$ 5,062.62**	**$ 5,925.93**	**$ 5,979.58**
YEAR 1													
(East Meter)		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00
Monthly Demand	kW	188.50	150.70	131.50	141.50	151.20	189.80	202.00	206.60	206.70	177.60	184.80	189.30
Energy Use	kWh	83,530.00	61,140.00	56,620.00	55,790.00	56,850.00	66,760.00	76,050.00	83,920.00	80,220.00	64,070.00	84,010.00	84,110.00
Hours Use	hours	443.13	405.71	430.57	394.28	375.99	351.74	376.49	406.20	388.10	360.75	454.60	444.32
FAC Charge		$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23
Demand Charge		$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 973.60	$ 983.34	$ 1,005.73	$ 1,006.22	$ 524.00	$ 524.00	$ 524.00
Energy Charge		$ 4,211.85	$ 3,165.35	$ 2,879.12	$ 2,914.20	$ 3,015.01	$ 4,237.87	$ 4,723.22	$ 5,092.26	$ 4,935.38	$ 3,444.55	$ 4,205.06	$ 4,237.80
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 5,323.30	$ 4,276.80	$ 3,990.56	$ 4,025.65	$ 4,126.45	$ 5,798.92	$ 6,294.00	$ 6,685.44	$ 6,529.04	$ 4,556.00	$ 5,316.51	$ 5,349.25
KC Franchise Fee		$ 591.48	$ 475.20	$ 443.40	$ 447.29	$ 458.49	$ 644.32	$ 699.33	$ 742.83	$ 725.45	$ 506.22	$ 590.72	$ 594.36
Total Cost		**$ 5,914.78**	**$ 4,752.00**	**$ 4,433.96**	**$ 4,472.94**	**$ 4,584.95**	**$ 6,443.24**	**$ 6,993.34**	**$ 7,428.27**	**$ 7,254.49**	**$ 5,062.22**	**$ 5,907.23**	**$ 5,943.61**
Total Savings	**$ 379.80**	**$ 45.71**	**$ 34.63**	**$ 23.49**	**$ 5.89**	**$ 1.19**	**$ 30.55**	**$ 120.95**	**$ 57.87**	**$ 4.45**	**$ 0.40**	**$ 18.70**	**$ 35.97**
YEAR 2+													
(East Meter)		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	207	207	207	207	207	207	207	207	207	207	207	207
Monthly Demand	kW	188.50	150.70	131.50	141.50	151.20	189.80	202.00	206.60	206.70	177.60	184.80	189.30
Energy Use	kWh	83,530.00	61,140.00	56,620.00	55,790.00	56,850.00	66,760.00	76,050.00	83,920.00	80,220.00	64,070.00	84,010.00	84,110.00
Hours Use	hours	443.13	405.71	430.57	394.28	375.99	351.74	376.49	406.20	388.10	360.75	454.60	444.32
FAC Charge		$ 504.67	$ 504.67	$ 504.67	$ 504.67	$ 504.67	$ 504.67	$ 504.67	$ 504.67	$ 504.67	$ 504.67	$ 504.67	$ 504.67
Demand Charge		$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 973.60	$ 983.34	$ 1,005.73	$ 1,006.22	$ 524.00	$ 524.00	$ 524.00
Energy Charge		$ 4,211.85	$ 3,165.35	$ 2,879.12	$ 2,914.20	$ 3,015.01	$ 4,237.87	$ 4,723.22	$ 5,092.26	$ 4,935.38	$ 3,444.55	$ 4,205.06	$ 4,237.80
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 5,325.74	$ 4,279.23	$ 3,993.00	$ 4,028.09	$ 4,128.89	$ 5,801.35	$ 6,296.44	$ 6,687.88	$ 6,531.48	$ 4,558.44	$ 5,318.95	$ 5,351.69
KC Franchise Fee		$ 591.75	$ 475.47	$ 443.67	$ 447.57	$ 458.77	$ 644.59	$ 699.60	$ 743.10	$ 725.72	$ 506.49	$ 590.99	$ 594.63
Total Cost		**$ 5,917.49**	**$ 4,754.70**	**$ 4,436.67**	**$ 4,475.65**	**$ 4,587.66**	**$ 6,445.95**	**$ 6,996.04**	**$ 7,430.97**	**$ 7,257.20**	**$ 5,064.93**	**$ 5,909.94**	**$ 5,946.32**
Total Savings	**$ 347.30**	**$ 43.00**	**$ 31.92**	**$ 20.78**	**$ 3.18**	**$ (1.52)**	**$ 27.85**	**$ 118.24**	**$ 55.16**	**$ 1.74**	**$ (2.31)**	**$ 15.99**	**$ 33.26**

Figure D.11. HVAC setup/setback east meter cost savings calculation

Current Cost - West Meter		Jan 2010	Feb 2010	Mar 2010	Apr 2010	May 2010	June 2010	July 2010	Aug 2010	Sept 2010	Oct 2010	Nov 2009	Dec 2009
Facilities Demand	kW	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00
Monthly Demand	kW	303.00	297.00	270.00	318.00	324.00	408.00	423.00	435.00	438.00	393.00	366.00	357.00
Energy Use	kWh	133,200.00	114,300.00	109,800.00	118,200.00	117,600.00	140,700.00	176,100.00	181,500.00	166,200.00	138,900.00	141,900.00	137,400.00
Hours Use	hours	439.60	384.85	406.67	371.70	362.96	344.85	416.31	417.24	379.45	353.44	387.70	384.87
FAC Charge		$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84
Demand Charge		$ 793.86	$ 778.14	$ 707.40	$ 833.16	$ 848.88	$ 1,986.14	$ 2,059.16	$ 2,117.58	$ 2,132.18	$ 1,029.66	$ 958.92	$ 935.34
Energy Charge		$ 6,732.00	$ 6,016.50	$ 5,680.44	$ 6,292.20	$ 6,309.60	$ 8,990.17	$ 10,608.37	$ 10,926.54	$ 10,296.79	$ 7,519.26	$ 7,451.70	$ 7,232.28
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,678.92	$ 7,947.70	$ 7,540.90	$ 8,278.42	$ 8,311.54	$ 12,129.38	$ 13,820.60	$ 14,197.18	$ 13,582.04	$ 9,701.98	$ 9,563.68	$ 9,320.68
KC Franchise Fee		$ 964.32	$ 883.08	$ 837.88	$ 919.82	$ 923.50	$ 1,347.71	$ 1,535.62	$ 1,577.46	$ 1,509.12	$ 1,078.00	$ 1,062.63	$ 1,035.63
Total Cost		**$ 9,643.25**	**$ 8,830.78**	**$ 8,378.78**	**$ 9,198.25**	**$ 9,235.05**	**$ 13,477.09**	**$ 15,356.22**	**$ 15,774.65**	**$ 15,091.16**	**$ 10,779.98**	**$ 10,626.32**	**$ 10,356.32**
YEAR 1													
(West Meter)		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00
Monthly Demand	kW	303.00	297.00	269.60	317.90	323.90	408.90	424.60	435.90	438.00	392.90	365.50	357.00
Energy Use	kWh	133,100.00	114,100.00	109,600.00	118,000.00	117,600.00	140,700.00	175,700.00	179,800.00	165,600.00	138,800.00	141,900.00	137,300.00
Hours Use	hours	439.27	384.18	406.53	371.19	363.08	344.09	413.80	412.48	378.08	353.27	388.24	384.59
FAC Charge		$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84
Demand Charge		$ 793.86	$ 778.14	$ 706.35	$ 832.90	$ 848.62	$ 1,990.53	$ 2,066.95	$ 2,121.96	$ 2,132.18	$ 1,029.40	$ 957.61	$ 935.34
Energy Charge		$ 6,728.42	$ 6,009.34	$ 5,670.69	$ 6,284.39	$ 6,308.95	$ 8,996.78	$ 10,603.08	$ 10,860.73	$ 10,271.23	$ 7,515.03	$ 7,448.46	$ 7,228.70
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,675.34	$ 7,940.54	$ 7,530.10	$ 8,270.35	$ 8,310.63	$ 12,140.37	$ 13,823.10	$ 14,135.75	$ 13,556.48	$ 9,697.49	$ 9,559.13	$ 9,317.10
KC Franchise Fee		$ 963.93	$ 882.28	$ 836.68	$ 918.93	$ 923.40	$ 1,348.93	$ 1,535.90	$ 1,570.64	$ 1,506.28	$ 1,077.50	$ 1,062.13	$ 1,035.23
Total Cost		**$ 9,639.27**	**$ 8,822.83**	**$ 8,366.78**	**$ 9,189.28**	**$ 9,234.04**	**$ 13,489.30**	**$ 15,359.00**	**$ 15,706.39**	**$ 15,062.76**	**$ 10,774.99**	**$ 10,621.26**	**$ 10,352.34**
Total Savings	**$ 129.60**	**$ 3.98**	**$ 7.96**	**$ 12.00**	**$ 8.97**	**$ 1.01**	**$ (12.21)**	**$ (2.78)**	**$ 68.25**	**$ 28.40**	**$ 4.99**	**$ 5.06**	**$ 3.98**
YEAR 2+													
(West Meter)		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	438	438	438	438	438	438	438	438	438	438	438	438
Monthly Demand	kW	303.00	297.00	269.60	317.90	323.90	408.90	424.60	435.90	438.00	392.90	365.50	357.00
Energy Use	kWh	133,100.00	114,100.00	109,600.00	118,000.00	117,600.00	140,700.00	175,700.00	179,800.00	165,600.00	138,800.00	141,900.00	137,300.00
Hours Use	hours	439.27	384.18	406.53	371.19	363.08	344.09	413.80	412.48	378.08	353.27	388.24	384.59
FAC Charge		$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84
Demand Charge		$ 793.86	$ 778.14	$ 706.35	$ 832.90	$ 848.62	$ 1,990.53	$ 2,066.95	$ 2,121.96	$ 2,132.18	$ 1,029.40	$ 957.61	$ 935.34
Energy Charge		$ 6,728.42	$ 6,009.34	$ 5,670.69	$ 6,284.39	$ 6,308.95	$ 8,996.78	$ 10,603.08	$ 10,860.73	$ 10,271.23	$ 7,515.03	$ 7,448.46	$ 7,228.70
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,675.34	$ 7,940.54	$ 7,530.10	$ 8,270.35	$ 8,310.63	$ 12,140.37	$ 13,823.10	$ 14,135.75	$ 13,556.48	$ 9,697.49	$ 9,559.13	$ 9,317.10
KC Franchise Fee		$ 963.93	$ 882.28	$ 836.68	$ 918.93	$ 923.40	$ 1,348.93	$ 1,535.90	$ 1,570.64	$ 1,506.28	$ 1,077.50	$ 1,062.13	$ 1,035.23
Total Cost		**$ 9,639.27**	**$ 8,822.83**	**$ 8,366.78**	**$ 9,189.28**	**$ 9,234.04**	**$ 13,489.30**	**$ 15,359.00**	**$ 15,706.39**	**$ 15,062.76**	**$ 10,774.99**	**$ 10,621.26**	**$ 10,352.34**
Total Savings	**$ 129.60**	**$ 3.98**	**$ 7.96**	**$ 12.00**	**$ 8.97**	**$ 1.01**	**$ (12.21)**	**$ (2.78)**	**$ 68.25**	**$ 28.40**	**$ 4.99**	**$ 5.06**	**$ 3.98**

Figure D.12. HVAC setup/setback west meter cost savings calculation

Current Cost - East Meter		Jan 2010	Feb 2010	Mar 2010	Apr 2010	May 2010	June 2010	July 2010	Aug 2010	Sept 2010	Oct 2010	Nov 2009	Dec 2009
Facilities Demand	kW	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00
Monthly Demand	kW	189.60	151.20	132.00	141.60	151.20	189.60	201.60	206.40	206.40	177.60	184.80	189.60
Energy Use	kWh	84,480.00	61,920.00	57,120.00	55,920.00	56,880.00	67,440.00	78,720.00	85,200.00	80,400.00	64,080.00	84,480.00	84,960.00
Hours Use	hours	445.57	409.52	432.73	394.92	376.19	355.70	390.48	412.79	389.53	360.81	457.14	448.10
FAC Charge		$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23
Demand Charge		$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 973.60	$ 981.39	$ 1,004.76	$ 1,004.76	$ 524.00	$ 524.00	$ 524.00
Energy Charge		$ 4,252.99	$ 3,196.51	$ 2,900.26	$ 2,919.50	$ 3,016.08	$ 4,265.37	$ 4,834.02	$ 5,145.32	$ 4,940.84	$ 3,444.91	$ 4,221.89	$ 4,270.18
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 5,364.44	$ 4,307.96	$ 4,011.70	$ 4,030.95	$ 4,127.53	$ 5,826.41	$ 6,402.86	$ 6,737.52	$ 6,533.04	$ 4,556.36	$ 5,333.34	$ 5,381.62
KC Franchise Fee		$ 596.05	$ 478.66	$ 445.74	$ 447.88	$ 458.61	$ 647.38	$ 711.43	$ 748.61	$ 725.89	$ 506.26	$ 592.59	$ 597.96
Total Cost		**$ 5,960.49**	**$ 4,786.62**	**$ 4,457.45**	**$ 4,478.84**	**$ 4,586.14**	**$ 6,473.79**	**$ 7,114.29**	**$ 7,486.14**	**$ 7,258.94**	**$ 5,062.62**	**$ 5,925.93**	**$ 5,979.58**
YEAR 1													
(East Meter)		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00	206.00
Monthly Demand	kW	185.80	144.90	118.80	127.50	139.90	188.90	201.20	205.60	197.80	163.30	171.10	182.30
Energy Use	kWh	83,510.00	61,040.00	55,690.00	53,150.00	54,070.00	64,120.00	74,970.00	82,000.00	77,560.00	61,440.00	82,642.00	83,980.00
Hours Use	hours	449.46	421.26	468.77	416.86	386.49	339.44	372.61	398.83	392.11	376.24	483.00	460.67
FAC Charge		$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23
Demand Charge		$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 973.60	$ 979.44	$ 1,000.86	$ 973.60	$ 524.00	$ 524.00	$ 524.00
Energy Charge		$ 4,193.64	$ 3,124.18	$ 2,763.53	$ 2,728.97	$ 2,842.26	$ 4,118.79	$ 4,671.33	$ 5,003.13	$ 4,756.70	$ 3,257.74	$ 4,067.31	$ 4,187.79
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 5,305.09	$ 4,235.63	$ 3,874.97	$ 3,840.42	$ 3,953.71	$ 5,679.84	$ 6,238.22	$ 6,591.44	$ 6,317.75	$ 4,369.18	$ 5,178.76	$ 5,299.24
KC Franchise Fee		$ 589.45	$ 470.63	$ 430.55	$ 426.71	$ 439.30	$ 631.09	$ 693.14	$ 732.38	$ 701.97	$ 485.46	$ 575.42	$ 588.80
Total Cost		**$ 5,894.54**	**$ 4,706.26**	**$ 4,305.53**	**$ 4,267.13**	**$ 4,393.01**	**$ 6,310.94**	**$ 6,931.36**	**$ 7,323.82**	**$ 7,019.72**	**$ 4,854.65**	**$ 5,754.18**	**$ 5,888.04**
Total Savings	**$ 1,921.67**	**$ 65.94**	**$ 80.36**	**$ 151.92**	**$ 211.70**	**$ 193.14**	**$ 162.86**	**$ 182.93**	**$ 162.32**	**$ 239.22**	**$ 207.97**	**$ 171.75**	**$ 91.54**
YEAR 2+													
(East Meter)		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	206	206	206	206	206	206	206	206	206	206	206	206
Monthly Demand	kW	185.80	144.90	118.80	127.50	139.90	188.90	201.20	205.60	197.80	163.30	171.10	182.30
Energy Use	kWh	83,510.00	61,040.00	55,690.00	53,150.00	54,070.00	64,120.00	74,970.00	82,000.00	77,560.00	61,440.00	82,642.00	83,980.00
Hours Use	hours	449.46	421.26	468.77	416.86	386.49	339.44	372.61	398.83	392.11	376.24	483.00	460.67
FAC Charge		$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23	$ 502.23
Demand Charge		$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 524.00	$ 973.60	$ 979.44	$ 1,000.86	$ 973.60	$ 524.00	$ 524.00	$ 524.00
Energy Charge		$ 4,193.64	$ 3,124.18	$ 2,763.53	$ 2,728.97	$ 2,842.26	$ 4,118.79	$ 4,671.33	$ 5,003.13	$ 4,756.70	$ 3,257.74	$ 4,067.31	$ 4,187.79
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 5,305.09	$ 4,235.63	$ 3,874.97	$ 3,840.42	$ 3,953.71	$ 5,679.84	$ 6,238.22	$ 6,591.44	$ 6,317.75	$ 4,369.18	$ 5,178.76	$ 5,299.24
KC Franchise Fee		$ 589.45	$ 470.63	$ 430.55	$ 426.71	$ 439.30	$ 631.09	$ 693.14	$ 732.38	$ 701.97	$ 485.46	$ 575.42	$ 588.80
Total Cost		**$ 5,894.54**	**$ 4,706.26**	**$ 4,305.53**	**$ 4,267.13**	**$ 4,393.01**	**$ 6,310.94**	**$ 6,931.36**	**$ 7,323.82**	**$ 7,019.72**	**$ 4,854.65**	**$ 5,754.18**	**$ 5,888.04**
Total Savings	**$ 1,921.67**	**$ 65.94**	**$ 80.36**	**$ 151.92**	**$ 211.70**	**$ 193.14**	**$ 162.86**	**$ 182.93**	**$ 162.32**	**$ 239.22**	**$ 207.97**	**$ 171.75**	**$ 91.54**

Figure D.13. HVAC occupied setpoint setup/setback east meter cost savings calculation

Current Cost - West Meter		Jan 2010	Feb 2010	Mar 2010	Apr 2010	May 2010	June 2010	July 2010	Aug 2010	Sept 2010	Oct 2010	Nov 2009	Dec 2009
Facilities Demand	kW	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00
Monthly Demand	kW	303.00	297.00	270.00	318.00	324.00	408.00	423.00	435.00	438.00	393.00	366.00	357.00
Energy Use	kWh	133,200.00	114,300.00	109,800.00	118,200.00	117,600.00	140,700.00	176,100.00	181,500.00	166,200.00	138,900.00	141,900.00	137,400.00
Hours Use	hours	439.60	384.85	406.67	371.70	362.96	344.85	416.31	417.24	379.45	353.44	387.70	384.87
FAC Charge		$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84
Demand Charge		$ 793.86	$ 778.14	$ 707.40	$ 833.16	$ 848.88	$ 1,986.14	$ 2,059.16	$ 2,117.58	$ 2,132.18	$ 1,029.66	$ 958.92	$ 935.34
Energy Charge		$ 6,732.00	$ 6,016.50	$ 5,680.44	$ 6,292.20	$ 6,309.60	$ 8,990.17	$ 10,608.37	$ 10,926.54	$ 10,296.79	$ 7,519.26	$ 7,451.70	$ 7,232.28
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,678.92	$ 7,947.70	$ 7,540.90	$ 8,278.42	$ 8,311.54	$ 12,129.38	$ 13,820.60	$ 14,197.18	$ 13,582.04	$ 9,701.98	$ 9,563.68	$ 9,320.68
KC Franchise Fee		$ 964.32	$ 883.08	$ 837.88	$ 919.82	$ 923.50	$ 1,347.71	$ 1,535.62	$ 1,577.46	$ 1,509.12	$ 1,078.00	$ 1,062.63	$ 1,035.63
Total Cost		**$ 9,643.25**	**$ 8,830.78**	**$ 8,378.78**	**$ 9,198.25**	**$ 9,235.05**	**$ 13,477.09**	**$ 15,356.22**	**$ 15,774.65**	**$ 15,091.16**	**$ 10,779.98**	**$ 10,626.32**	**$ 10,356.32**
YEAR 1													
(West Meter)		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00	438.00
Monthly Demand	kW	303.00	297.00	268.10	315.00	319.50	404.60	420.10	431.40	435.10	389.60	362.40	357.00
Energy Use	kWh	133,100.00	114,100.00	109,600.00	117,800.00	117,100.00	139,300.00	173,500.00	179,900.00	165,300.00	138,500.00	141,800.00	137,200.00
Hours Use	hours	439.27	384.18	408.80	373.97	366.51	344.29	413.00	417.01	379.91	355.49	391.28	384.31
FAC Charge		$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84	$ 1,067.84
Demand Charge		$ 793.86	$ 778.14	$ 702.42	$ 825.30	$ 837.09	$ 1,969.59	$ 2,045.05	$ 2,100.06	$ 2,118.07	$ 1,020.75	$ 949.49	$ 935.34
Energy Charge		$ 6,728.42	$ 6,009.34	$ 5,660.97	$ 6,258.44	$ 6,262.54	$ 8,905.56	$ 10,476.31	$ 10,831.94	$ 10,237.15	$ 7,482.91	$ 7,424.79	$ 7,225.12
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,675.34	$ 7,940.54	$ 7,516.45	$ 8,236.80	$ 8,252.69	$ 12,028.22	$ 13,674.43	$ 14,085.06	$ 13,508.29	$ 9,656.72	$ 9,527.34	$ 9,313.52
KC Franchise Fee		$ 963.93	$ 882.28	$ 835.16	$ 915.20	$ 916.97	$ 1,336.47	$ 1,519.38	$ 1,565.01	$ 1,500.92	$ 1,072.97	$ 1,058.59	$ 1,034.84
Total Cost		**$ 9,639.27**	**$ 8,822.83**	**$ 8,351.62**	**$ 9,152.00**	**$ 9,169.66**	**$ 13,364.69**	**$ 15,193.81**	**$ 15,650.07**	**$ 15,009.21**	**$ 10,729.69**	**$ 10,585.94**	**$ 10,348.36**
Total Savings	**$ 730.70**	**$ 3.98**	**$ 7.96**	**$ 27.17**	**$ 46.24**	**$ 65.39**	**$ 112.40**	**$ 162.42**	**$ 124.58**	**$ 81.95**	**$ 50.29**	**$ 40.38**	**$ 7.96**
YEAR 2+													
(West Meter)		**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Facilities Demand	kW	435	435	435	435	435	435	435	435	435	435	435	435
Monthly Demand	kW	303.00	297.00	268.10	315.00	319.50	404.60	420.10	431.40	435.10	389.60	362.40	357.00
Energy Use	kWh	133,100.00	114,100.00	109,600.00	117,800.00	117,100.00	139,300.00	173,500.00	179,900.00	165,300.00	138,500.00	141,800.00	137,200.00
Hours Use	hours	439.27	384.18	408.80	373.97	366.51	344.29	413.00	417.01	379.91	355.49	391.28	384.31
FAC Charge		$ 1,060.53	$ 1,060.53	$ 1,060.53	$ 1,060.53	$ 1,060.53	$ 1,060.53	$ 1,060.53	$ 1,060.53	$ 1,060.53	$ 1,060.53	$ 1,060.53	$ 1,060.53
Demand Charge		$ 793.86	$ 778.14	$ 702.42	$ 825.30	$ 837.09	$ 1,969.59	$ 2,045.05	$ 2,100.06	$ 2,118.07	$ 1,020.75	$ 949.49	$ 935.34
Energy Charge		$ 6,728.42	$ 6,009.34	$ 5,660.97	$ 6,258.44	$ 6,262.54	$ 8,905.56	$ 10,476.31	$ 10,831.94	$ 10,237.15	$ 7,482.91	$ 7,424.79	$ 7,225.12
Customer Charge		$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22	$ 85.22
SubTotal		$ 8,668.03	$ 7,933.23	$ 7,509.14	$ 8,229.49	$ 8,245.38	$ 12,020.91	$ 13,667.11	$ 14,077.75	$ 13,500.97	$ 9,649.41	$ 9,520.03	$ 9,306.21
KC Franchise Fee		$ 963.11	$ 881.47	$ 834.35	$ 914.39	$ 916.15	$ 1,335.66	$ 1,518.57	$ 1,564.19	$ 1,500.11	$ 1,072.16	$ 1,057.78	$ 1,034.02
Total Cost		**$ 9,631.14**	**$ 8,814.70**	**$ 8,343.49**	**$ 9,143.88**	**$ 9,161.53**	**$ 13,356.56**	**$ 15,185.68**	**$ 15,641.94**	**$ 15,001.08**	**$ 10,721.57**	**$ 10,577.81**	**$ 10,340.23**
Total Savings	**$ 828.22**	**$ 12.10**	**$ 16.08**	**$ 35.29**	**$ 54.37**	**$ 73.52**	**$ 120.53**	**$ 170.54**	**$ 132.71**	**$ 90.08**	**$ 58.42**	**$ 48.50**	**$ 16.08**

Figure D.14. HVAC occupied setpoint setup/setback west meter cost savings calculation

Figure D.15. HVAC setup/setback natural gas cost savings calculation

Cost Savings-East Building	Jan 2010	Feb 2010	Mar 2010	Apr 2010	May 2010	June 2010	July 2010	Aug 2010	Sept 2010	Oct 2010	Nov 2009	Dec 2009
Service Charge	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66
Vol Delivery Charge	$ 92.91	$ 73.97	$ 38.52	$ 4.13	$ -	$ -	$ -	$ -	$ -	$ 0.15	$ 42.23	$ 82.55
Usage Charge	$ 598.46	$ 476.46	$ 248.12	$ 46.16	$ -	$ -	$ -	$ -	$ -	$ 1.65	$ 272.03	$ 531.69
Subtotal	$ 747.03	$ 606.09	$ 342.30	$ 105.95	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 57.45	$ 369.92	$ 669.89
City Franchise Fee	$ 83.00	$ 67.34	$ 38.03	$ 11.77	$ 6.18	$ 6.18	$ 6.18	$ 6.18	$ 6.18	$ 6.38	$ 41.10	$ 74.43
Monthly Total	$ 830.04	$ 673.43	$ 380.33	$ 117.72	$ 61.84	$ 61.84	$ 61.84	$ 61.84	$ 61.84	$ 63.83	$ 411.02	$ 744.33
Yearly Total	$ 3,529.90											
Cost Savings-West Building	**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Service Charge	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66
Vol Delivery Charge	$ 34.68	$ 29.82	$ 28.54	$ 9.44	$ 1.70	$ -	$ -	$ -	$ 0.66	$ 7.30	$ 28.80	$ 32.25
Usage Charge	$ 223.39	$ 192.07	$ 183.83	$ 105.51	$ 18.96	$ -	$ -	$ -	$ 7.42	$ 81.61	$ 185.47	$ 207.73
Subtotal	$ 313.73	$ 277.54	$ 268.02	$ 170.61	$ 76.31	$ 55.66	$ 55.66	$ 55.66	$ 63.74	$ 144.57	$ 269.92	$ 295.64
City Franchise Fee	$ 34.86	$ 30.84	$ 29.78	$ 18.96	$ 8.48	$ 6.18	$ 6.18	$ 6.18	$ 7.08	$ 16.06	$ 29.99	$ 32.85
Monthly Total	$ 348.59	$ 308.38	$ 297.80	$ 189.57	$ 84.79	$ 61.84	$ 61.84	$ 61.84	$ 70.82	$ 160.63	$ 299.92	$ 328.49
Yearly Total	$ 2,274.50											

Figure D.16. HVAC occupied setpoint setup/setback natural gas cost savings calculation

Cost Savings-East Building	Jan 2010	Feb 2010	Mar 2010	Apr 2010	May 2010	June 2010	July 2010	Aug 2010	Sept 2010	Oct 2010	Nov 2009	Dec 2009
Service Charge	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66
Vol Delivery Charge	$ 91.38	$ 73.72	$ 44.28	$ 7.38	$ 3.32	$ 0.74	$ 0.07	$ 0.59	$ 1.70	$ 3.98	$ 50.68	$ 82.29
Usage Charge	$ 588.57	$ 474.81	$ 285.22	$ 82.43	$ 37.09	$ 8.24	$ 0.82	$ 6.59	$ 18.96	$ 44.51	$ 326.43	$ 530.04
Subtotal	$ 735.60	$ 604.19	$ 385.15	$ 145.46	$ 96.07	$ 64.64	$ 56.55	$ 62.84	$ 76.31	$ 104.15	$ 432.77	$ 667.99
City Franchise Fee	$ 81.73	$ 67.13	$ 42.79	$ 16.16	$ 10.67	$ 7.18	$ 6.28	$ 6.98	$ 8.48	$ 11.57	$ 48.09	$ 74.22
Monthly Total	$ 817.34	$ 671.32	$ 427.95	$ 161.63	$ 106.74	$ 71.82	$ 62.84	$ 69.82	$ 84.79	$ 115.72	$ 480.86	$ 742.21
Yearly Total	$ 3,813.03											
Cost Savings-West Building	**Jan 2010**	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**June 2010**	**July 2010**	**Aug 2010**	**Sept 2010**	**Oct 2010**	**Nov 2009**	**Dec 2009**
Service Charge	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66	$ 55.66
Vol Delivery Charge	$ 33.15	$ 28.03	$ 26.11	$ 8.63	$ 1.33	$ 0.07	$ -	$ -	$ 0.74	$ 6.42	$ 26.75	$ 30.08
Usage Charge	$ 213.50	$ 180.53	$ 168.16	$ 96.45	$ 14.84	$ 0.82	$ -	$ -	$ 8.24	$ 71.72	$ 172.28	$ 193.72
Subtotal	$ 302.30	$ 264.21	$ 249.93	$ 160.73	$ 71.82	$ 56.55	$ 55.66	$ 55.66	$ 64.64	$ 133.79	$ 254.69	$ 279.45
City Franchise Fee	$ 33.59	$ 29.36	$ 27.77	$ 17.86	$ 7.98	$ 6.28	$ 6.18	$ 6.18	$ 7.18	$ 14.87	$ 28.30	$ 31.05
Monthly Total	$ 335.89	$ 293.57	$ 277.70	$ 178.59	$ 79.80	$ 62.84	$ 61.84	$ 61.84	$ 71.82	$ 148.65	$ 282.99	$ 310.50
Yearly Total	$ 2,166.02											